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Outdoor Recreation

Physiological and Psychological Effects on Health

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Outdoor Recreation - Physiological and Psychological Effects on Health

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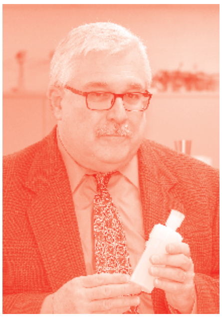



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Meet the editor

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Contents

Preface XIII

Acknowledgments V

Chapter 1 1
Introductory Chapter: Outdoor Recreation - Physiological and Psychological Effects on Health
by Hilde Dorthea Grindvik Nielsen

Chapter 2 5
Outdoor Recreation: Physiological Effects and Prevention of Socially Important Diseases
by Nikolay Boyadjiev, Katerina Nikolova Georgieva and Penka Angelova Angelova Hristova

Chapter 3 25
Physiological Responses to Outdoor Recreation: How it Can Help you Prepare your Outdoor Activity and How to Intervene
by Andrée-Anne Parent and Tegwen Gadais

Chapter 4 45
Outdoor Recreation within the School Setting: A Physiological and Psychological Exploration
by Brendon Patrick Hyndman and Shirley Wyver

Chapter 5 63
Introducing Park Facilities and Noveltiesto Support Individual's Intention to (Re)Visit
by Marija Opačak

Chapter 6 79
Folk-Based Outdoor Games as Means to Improve the Physical Activity and Emotional Well-Being of Pre-School Children
by Maria Leont'eva and Tatiana Levchenkova

Preface

This book comprises six chapters. The first chapter is the introductory chapter. The second chapter, Outdoor Recreation: Physiological Effects and Prevention of Socially Important Diseases, addresses the physiological effects of different kinds of outdoor recreation in relation to the intensity of the activity and assesses their benefits in the prevention of socially important diseases.

In Chapter three, Physiological Responses to Outdoor Recreation: How it Can Help you Prepare your Outdoor Activity and How to Intervene, you will be introduced to human physiological responses to different environmental challenges; thermoregulation, energy demand, musculoskeletal injury risks, sleep and recovery during outdoor activities and how to better prepare for them in the wild. Better understanding of possible incidents that can be encountered in outdoor recreation activities can improve the planning and risk mitigation. The chapter comprises guidelines for how to behave in various situations.

A great opportunity to create new interest in outdoor activity is to get children to participate from an early age. On the other hand, it should be mentioned that many adults start to get interested in their adulthood. To make outdoor recreation natural for children, they should be exposed to the activity in kindergarten and at school. The activity must feel fun and enjoyable for the children, and very importantly, affordable. The recess at school is a nice place to start. There, the children can participate on their own terms. The aspirations should be that the children are happy to be outside and active. You can read more about this in Chapter four: Outdoor Recreation within the School Setting: A Physiological and Psychological Exploration.

Outdoor recreation can be subdivided into two categories: nature-based recreation and user-based recreation such as parks. The need for public parks is increasing, especially in very urbanized areas. People need a place to be outdoors in the cities. The problem very often is to find good locations as well as the financing for building the parks. In Chapter five, Introducing Park Facilities and Novelties to Support Individual's Intention to (Re) Visit, you can learn how policymakers could consider brownfield regeneration more efficiently.

The cost of building a park is high, but in the long run, outdoor activity in parks etc. can contribute to reduced costs in the hospital sector, for example. There is a preventive public health effect in having green areas available in the big cities.

In Chapter six, Folk-Based Outdoor Games as Means to Improve the Physical Activity and Emotional Well-Being of Pre-School Children, you can read about how Russian folklore can be used as an activity to stimulate to outdoor activity. This type of activity is useful for teachers or other personnel working with children and has a documented effect on the children's motion abilities and cardiovascular and respiratory systems.

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The themes of the chapters in the book are entirely the authors' ideas. Thanks to the authors for their great contributions.

I would also like to thank IntechOpen for cooperation during this book project.

Chapter 1

Introductory Chapter: Outdoor Recreation - Physiological and Psychological Effects on Health

Hilde Dorthea Grindvik Nielsen

1. Introduction

The interest for creating this book started with a desire to communicate how valuable it is for a healthy live to be physically active outdoor in the nature or in parks. Outdoor recreation activities are adapted for pleasure, exercise, challenge, friendship, and a natural opening to become a part of the nature or be a user of public parks. Everyone can participate in outdoor recreation activities; it is not necessary to be a sports athlete to participate.

Outdoor recreation can be defined as any leisure time activity which is being conducted outdoor in which individuals engage themselves [1]. The wide range of activities are divided into two classifications: resource-based and user-oriented recreation [1]. The resource-based recreation is known to be performed in natural settings, while user-oriented recreation can be presented anywhere such as in parks [1].

Traditional examples of outdoor activities are camping, canoeing, caving, climbing, cycling, fishing, hiking, horse riding, hunting, mountaineering, kayaking, rafting, rock running, sailing, skiing, sky diving, and surfing. But outdoor recreation is in continuous development and now also includes activities as canyoning, coasteering, fastpacking, and plogging, to mention some.

People have been fishing and hunting since the start of human history. Today, some of the activities which were earlier executed for surviving are executed as a hobby or leisure activity, especially in the part of the world in which everything is industrialized and modernized. In these wealthy parts of the world, outdoor recreation is something people do in weekends or on holiday leaves. It is well documented in the literature that outdoor recreation activities, among several other factors, are important for a healthy life [2, 3].

Urban planning is a process for managing the physical development of cities. Even small towns are built according to a plan that defines the layout and location of city streets, squares, quarters, downtown areas, business districts, green areas, and residential areas. Central park in New York (USA), the Promenade des Anglais in Nice (France) and Hyde park in London (UK) are famous examples. It is a challenge to allocate available space in the cities for recreational areas, a demanding task for the city planners. Efficient utilization of limited areas is not easy in already overcrowded cities.

There are many health benefits with executing outdoor recreation activities. If you are lucky and live in a country/area in which the level of air pollution is low you get fresh air; moreover, it gives you a break from your ordinary daily life. Outdoor recreation strengthens the physical and mental health and increases the quality of life [2, 3]. A study from year 2000 shows that 90 percent of the respondents who said they participate in regular outdoor recreation were more satisfied with their overall lives compared to the 60 percent who reported non-outdoor activities [4].

In countries where mountains and forests are easily accessible and not crowded with inhabitants and buildings, *e.g.* Norway, outdoor recreation has had a significant growth during the Covid-19 pandemic. Luckily, Norway, with its 5 million inhabitants, has large areas for executing outdoor recreation. The increasing interest for outdoor recreation activities does not, of course, involve everyone. In fact, those who are already physically active has a lower threshold to start with outdoor recreation activities in addition to the "ordinary" physical activities. Still, the interest for outdoor recreation has reached more people than before.

The climate problem can be considered the largest challenge for humanity as of today. Weather forecasts can in many places regularly deliver detailed information on levels of ozone, air pollutants, pollen, and ultraviolet radiation (UVR) exposure, along with warnings when too high or too low temperatures levels may become dangerous to health. This will in the future influence our behavior for outdoor recreation/outdoor physical activity [5] even more than today. More rainy days, too hot weather or too much ice and snow will limit people's habits for being physical active outdoor. Good planning and right facilitation of the outdoor activities are essential for a good and memorable outdoor experience and for the continued interest for such activities in the general population.

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The themes of the chapters in the book are entirely the authors' ideas. Thanks to the authors for their great contributions.

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Chapter 2

Outdoor Recreation: Physiological Effects and Prevention of Socially Important Diseases

Nikolay Boyadjiev, Katerina Nikolova Georgieva and Penka Angelova Angelova Hristova

Abstract

Physical activity improves the condition of the cardiovascular system, respiration, muscles, and metabolism and increases physical working capacity. This review of physiological effects and adaptation mechanisms of the outdoor recreation and its health benefits provides accessible information from a scientific point of view and research practice. Increased frequency of many socially important diseases such as diabetes mellitus type 2, metabolic syndrome and obesity, cardiovascular diseases, and others is associated with dramatically decreased physical activity in the last decades. Outdoor recreation for children, adolescents, adults, and older population is important for the prevention of these conditions. In this chapter, the authors describe in detail the physiological effects of different kinds of outdoor recreation physical activity with different intensities (such as walking, cycling, skiing, rowing, climbing, practicing some outdoor sports, etc.) and assess their benefits in the prevention of socially important diseases.

Keywords: outdoor recreation, adaptation, working capacity, physical activity, functional systems, socially important diseases

1. Physiological adaptation to outdoor recreation physical activity

Outdoor recreation physical activity includes a wide range of physical exercises that vary in structure, volume, and intensity. The structure is determined by whether the muscles perform static or dynamic work, the volume depends on the work (measured in kgm or J), and the intensity relates to the power (work done per unit time—W).

The changes that occur in the body (in muscles, cardiovascular, respiratory, and endocrine systems, blood, etc.) as a result of recreational physical exercises can be momentary or permanent. The momentary ones provide the immediate needs of the body during the performance of the exercise itself, and the permanent ones occur mostly as a result of systematic practice of recreational physical activity and are defined as adaptive.

The latter vary significantly depending on the type of recreational activity, as a result of which they occur and affect almost all functional systems of the body, such as cardiovascular, respiratory, endocrine, nervous, and blood systems, with significant changes occurring in both the muscles and the ability to adjust the thermoregulatory mechanisms, those which maintain the water and electrolyte balance, and acid–base balance of the body. Even the mechanisms involved in the individual's immune response are affected.

From a physiological point of view, it is important to answer questions, such as how the body responds to incidental recreational physical exercise, how it adapts to systematic outdoor recreation accompanied by physical activity, what are the mechanisms of the process of maladaptation, etc. On the other hand, it is important to differentiate the changes that occur with the different types of recreational exercise, with those of predominant aerobic energy supply (walking, running, cycling, swimming, and cross-country skiing), or of predominant anaerobic exercise (canoeing, rock climbing, rafting, etc.). Depending on the intensity, duration, nature, and structure of movements, physical exercises trigger different energy mechanisms. It is accepted that physical exercises are divided into cyclic and acyclic, according to the structure of movements. The cyclic ones involve uniform movements that are repeated (walking, running, and swimming). The acyclic exercises include sets of movements of varying complexity (in the exercise of surfing and rock climbing), and there may be combinations of cyclic and acyclic ones, as for example, in sports games.

According to the type of muscular activity, recreational physical exercises are divided into dynamic and static ones. The dynamic ones include successive phases of muscle contraction and relaxation, while with static exercises, muscles remain contracted for some time (concentric or isometric) [1].

1.1 Adaptation of the cardiovascular system to systematic outdoor recreation physical activity

The main task of the cardiovascular (performed in conjunction with the respiratory) system is to provide tissues with oxygen and nutrients, to eliminate carbon dioxide and end products of metabolism, to maintain body temperature, and to carry hormones from the endocrine glands to the target organs. To effectively perform these functions, the cardiovascular system must respond adequately to the enhanced (to a greater or lesser extent) muscular activity when carrying out outdoor recreation physical activity.

Almost without exception, the response is directly proportional to the oxygen needs of the muscles for each level of such exercise, as the consumption of oxygen in them increases linearly with the increase of its intensity [2].

1.1.1 Cardiac output

Cardiac output is a function of stroke volume and heart rate. And maximum oxygen consumption (VO_{2max}), in its turn, is a function of the cardiac output multiplied by the difference in the oxygen content of arterial and mixed venous blood. The cardiac output plays a key role in meeting the oxygen needs during outdoor recreational physical activity. As intensity increases, the cardiac output also goes almost linearly up to the point where the maximum capacity of the heart to pump blood is reached (Q_{max}). Under normal conditions, with the gradual increase of workload, the cardiac output and heart rate also increase progressively while the stroke volume increases only up to the so-called individual "critical frequency" of heart activity, which varies depending on the age and training of the individual. Studies conducted with people regularly practicing outdoor recreational sports show that their stroke volume continues to rise almost until the maximum load is reached [1].

1.1.2 Blood flow

The picture of the distribution of blood flow changes substantially at the very beginning of the recreational exercise. At rest, the skin and skeletal muscles receive about 20% of cardiac output. During physical work, the blood is forwarded to the active muscles, and when the body temperature rises, more blood flows to the skin. This process is mediated by the increased cardiac output and redistribution of the blood which “withdraws” from the deficient (mainly splanchnic) areas to satisfy those areas with increased needs (muscle and skin) of oxygen and nutrients. The mechanism allows, at high intensity of work, about 80% of the cardiac output to be forwarded exactly to the muscles and skin. In case of prolonged exercises performed at high temperature and humidity, most of the blood is flown to the skin to carry out effective thermoregulation, what restricts the flow to the muscles, and hence—endurance.

1.1.3 Arterial blood pressure

The average blood pressure increases in response to dynamic physical exercise, mainly at the expense of the systolic one, as the diastolic pressure remains in most cases close to that at rest. As the intensity of exercise increases, the values of the systolic blood pressure increase linearly, and they can reach up to 200–240 mmHg in normotensive people. The average blood pressure does not change dramatically, as the increase of cardiac output (affecting mainly the systolic pressure) is accompanied by a decrease of peripheral vascular resistance (which determines to a greater extent the diastolic pressure). The increase of this pressure is a positive result and is associated with “resetting” the baroreceptor reflexes and triggering them at higher average pressure. Without such a reset phenomenon, severe arterial hypotension would occur during physical exercise. Hypertensive patients show significantly higher values of systolic pressure at a given intensity of performed exercise than normotensive ones, and they have increase of diastolic pressure as well. This leads to significantly higher values of the average blood pressure, and it is associated with a smaller degree of decrease of the peripheral vascular resistance in this group. In the first 2–3 hours following exercise, the blood pressure has values lower than before, a phenomenon described as *postexercise hypotension.* Its mechanisms are not clear.

1.1.4 Oxygen utilization in tissues

The arteriovenous oxygen difference (A-vO_2) increases with the increased intensity of the performed exercise and is explained by the increased transfer of oxygen from the arterial blood to the muscles. At rest, A-vO_2 is 4–5 ml O_2 on the average for each 100 ml blood (ml/100 ml). When the performed exercise acquires maximum intensity, the arteriovenous oxygen difference reaches values of 15–16 ml/100 ml blood.

1.1.5 Coronary circulation

The heart is supplied with oxygen and nutrients through the coronary arteries. The left and right coronary arteries are located on its surface. They branch out and penetrate deeply into the muscle fibers, forming a dense capillary network that is intended to supply every single muscle fiber, on the principle of one capillary for one muscle fiber. Both at rest and during physical exercise, the coronary blood flow is closely related to the myocardial oxygen demand. This coupling is necessary because the work of the heart depends almost entirely on the aerobic metabolism and therefore requires a constant supply of oxygen. Even at rest, the myocardial oxygen utilization corresponding to the blood flow is extremely high. About 70–80% of the oxygen stored in each unit volume of blood which passed through the myocardial capillary bed is transmitted to the myocardium. For comparison, at rest, this percentage in skeletal muscles is only 25. With a healthy heart, there is a linear correlation between the value of the myocardial oxygen demand, the coronary blood flow, and the oxygen consumption, as synchronization is carried out at each cardiac contraction. The three main determinants of the myocardial oxygen consumption include heart rate, myocardial contractility, and blood pressure on the ventricular wall. A sudden rise in arterial blood pressure increases the pressure on the ventricular wall, which in turn increases the level of myocardial metabolism, and hence—the coronary blood flow. The increase in coronary circulation results from the increased perfusion pressure in the coronary arteries and from the coronary vasodilatation following the sympathicotonia and the increased concentration of catecholamines.

1.1.6 Muscular circulation

Blood flow through the muscles increases substantially during physical activity. This is explained by the task of the cardiovascular system to provide them with an adequate supply of oxygen and nutrients. Muscle blood flow of the calf, for example, at a 6-minute moderate rhythmic contraction, increases more than 10 times during muscle relaxation but decreases rhythmically during each contraction, as a result of the compression of blood vessels by the contraction. Therefore, strong, prolonged, tonic contractions of muscles cause fast occurrence of fatigue coming from oxygen deficiency and depletion of nutrients therein.

During intense exercise, blood flow can increase about 25 times: from 3.6 up to 90 ml/100 g muscle tissue/minute. The main reason for this is the increased muscle metabolism. Increased arterial blood pressure during physical activity causes stretching of the walls of the arterioles and a decrease in the peripheral vascular resistance, which also increases muscle blood flow.

1.2 Adaptation of the respiratory system to systematic outdoor recreation physical activity

1.2.1 Changes in pulmonary ventilation and oxygen consumption during exercise

Oxygen consumption at rest is 250 ml/minute on the average. In recreation physical activity, it can increase substantially: up to 3500 ml/minute with an untrained individual and up to above 5000 ml/minute, for example, with a well-trained long-distance runner.

The relationship between pulmonary ventilation and oxygen consumption in intensity ascending physical activity is linear, as with a trained individual, at the end of the exercise (where maximum intensity is reached), an increase of nearly 20 times of ventilation is available as compared to the values at rest.

At maximum intensity of physical activity, pulmonary ventilation can reach up to 100–110 l/minute, which is about 50% lower than the maximum respiratory capacity. This provides an additional reserve to the body, which can be added in the case of physical exercise at high altitudes or at high temperature.

The increased tissue production of CO_2, the increased temperature as a result of muscle contractions, and the reduced pH in the muscles, shift the location of the oxyhemoglobin dissociation curve to the right in the coordinate system. This is also facilitated by the increase of 2,3-diphosphoglycerate in erythrocytes as they pass through the capillaries in tissues with low pO_2 and in muscles with intense anaerobic glycolysis. Thus, the release of O_2 from the blood into tissues with increased metabolism, including in the muscles, is facilitated. As a result of the above, the arteriovenous difference in blood oxygen content can increase from 5 to 15 ml/100 ml.

It could be expected that during prolonged exercise of moderate intensity where the oxygen utilization and carbon dioxide production in the muscles are significant, the oxygen pressure in arterial blood decreases, and that of carbon dioxide in venous blood increases. This does not occur due to the large ventilation capacity of the respiratory system, which provides adequate aeration of the blood even during strenuous physical exercise. When carrying out physical activity, it is not so much the changes in blood-gas tension as the neural factors that are the incentive for increasing the pulmonary ventilation. Such is the impact of the motor cortex and the sensory signals, which reach the respiratory center. These regulatory effects are sufficient to maintain normal blood-gas tension even during strenuous physical exercise.

It should be noted that the functional capacity of the respiratory system is not limited to the oxygen supply to the muscles. In the state of intensive aerobic metabolism, as is common in most cases of outdoor recreation physical activity, the ability of the heart to pump blood to the muscles is limited, which is adequate to their needs in the regime of aerobic exercise [3, 4].

The systematic practice of outdoor recreation physical activity of aerobic type increases the diffusion capacity of oxygen through the respiratory barrier, i.e. the amount of oxygen that diffuses through it in 1 minute, with a difference between the partial pressure of oxygen in the alveoli and its tension in the alveolar capillaries of 1 mmHg. While people without physical activity have a diffusion oxygen capacity at rest of about 24 mlO_2/minute, in individuals who practice outdoor sports, this figure can reach values up to 80 mlO_2/minute during exercise. The reason is that the pulmonary circulation increases (all pulmonary capillaries are perfused to the maximum extent), which also provides a maximum diffusion surface through which oxygen passes into the capillary blood.

1.3 Adaptation of muscles to systematic outdoor recreation physical activity

Muscles are significantly affected by the way they are used in everyday life. If the motoneurons that innervate the muscle fibers are disrupted, or destroyed for some reason, the so-called *denervation atrophy* occurs. It is distinguished by a reduction in the size of the denervated muscle fibers and of the amount of contractile proteins therein. The muscle can atrophy even with normal innervation, however, when not used for a long time, i.e. in case of prolonged immobilization (for example, as in a limb fracture). With enhanced physical activity, accompanied by increased contraction of certain muscles, the opposite state is reached—*muscle hypertrophy*. The size of the fibers gets larger and their chemical composition changes. It is assumed that the number of muscle fibers remains constant in elderly people, and the changes that occur with atrophy and hypertrophy affect only a change in their size and metabolic capacity [5, 6]. However, a number of studies recently conducted on humans and animals evidence that physical exercise can stimulate satellite cells (monopotent myogenic stem cells) in skeletal muscles to myoblast proliferation and the emergence of new muscle fibers in the process of adaptation to enhanced activity [7].

Human skeletal muscles are made of three main types of fibers. Depending on their rate of contraction, metabolic characteristics, and fatiguability, they are divided into type I (SO—slow oxidative)—slow-twitch, with high oxidative capacity, resistant to fatigue; type IIa (FOG—fast oxidative-glycolytic)—fast-twitch, oxidative-glycolytic, relatively resistant to fatigue, and type IIb (FG—fast glycolytic)—fast-twitch, with high glycolytic capacity, fatigable [8]. Their ratio and cross-section in the various muscles largely determine the differences in their contractile and metabolic characteristics.

The aerobic physical exercise, which is characterized by low intensity and longer duration (such as long-distance running and swimming) causes an increase in the number of mitochondria in type I and type IIa muscle fibers, which are most actively involved in this kind of physical work. The activity of oxidative enzymes in them increases. The amount of capillaries around these fibers increases. All this strengthens their endurance. Interestingly, the diameter of the muscle fibers decreases slightly what also leads to a lesser strength of the muscle fibers at the background of their enhanced endurance. In addition to muscles, exercises of this kind cause changes in all systems involved in the supply of oxygen thereto (respiratory, blood, and cardiovascular system) what provides a more efficient supply of oxygen to muscles for the oxidative energy production. This, combined with the enhanced capillarization of myofibers, shortens the diffusion distance of oxygen, metabolites, and heat and may increase the endurance [9, 10].

On the other hand, anaerobic physical exercises that are characterized by high intensity and short duration (weightlifting) mainly affect the fast-twitch, glycolytic muscle fibers (type IIb). These fibers increase in diameter due to the increased synthesis of contractile proteins. The synthesis and activity of glycolytic enzymes in them increase. Eventually, muscle strength increases, but endurance capacity is negligible and such muscles get tired easily.

Insofar as the different types of physical activity of the muscles cause different changes in their strength and endurance, each person can individually choose his/her way of training for the development of one or other quality. For example, weightlifting training causes muscle hypertrophy, and systematic long-distance running or cycling increases endurance. Practicing some physical exercises affects both qualities of the muscles.

It takes 6–8 weeks and sometimes months of recurring training sessions for the above changes to occur. After their cessation, however, there is a slow return to the initial condition [11].

Aging process is associated with changes in muscle mass and muscle strength with decline of maximal muscle strength after the 30th life year [12]. The reason is related to the decrease of the diameter of the muscle fibers, which in turn comes from the reduced physical activity. Systematic muscle training in adult life can prevent this process. It should be taken into account that with age, the adaptive capacity of the muscles decreases, e.g. the same intensity and duration of training sessions in older individuals do not cause such apparent changes as observed in younger ones. This can be explained by the disruption of the mechanisms that drive the transcription and translation of information from genes into muscle proteins. Regardless of aging, both systematic endurance exercises due to their beneficial effect on muscles and cardiovascular system and moderate exercises for strength to prevent atrophic changes in the striated muscles are recommended as recreational.

Intense strain of the muscles of an individual who has not adapted thereto causes reduced working capacity the next day. It is due to microlesions in the muscle tissue, which are the cause of moderate aseptic inflammation in it (DOMS = Delayed Onset Muscle Soreness). A more significant inflammatory reaction can be observed after muscle contractions while lifting a serious weight, in which case they get elongated, and this leads to more expressed damage to muscle cells as compared to those observed in isotonic and isometric contractions.

As an adaptive phenomenon, muscle strength can only increase when the contraction occurs against a certain resistance, i.e. muscles to be "forced" to develop more than 50% of their maximum strength. If an untrained individual is subject to such exercises, he/she can increase the maximum power of contraction of a muscle or a group of muscles by nearly 20% for about 4 weeks. However, the maximum effect is achieved for a period of 6–8 weeks, at the end of which the power of contraction may further increase by another 10% of the initial values.

Each skeletal muscle has a different distribution of fast- and slow-twitch fibers. M. gastrocnemius, for example, has predominantly fast-twitch fibers what determines its purpose—to allow for fast and powerful contractions when jumping.

On the other hand, m. soleus consists almost entirely of slow-twitch fibers what makes it particularly effective in prolonged contractions of the muscles of the lower limbs. The fast-twitch fibers allow the muscles to perform powerful contractions of short duration—from a few seconds to a minute. The slow-twitch fibers provide for endurance in prolonged contractions of less power. The distribution of fiber types is genetically determined and varies considerably for one and the same muscle in different people what makes some people more suitable to practice sprinting, others long-distance running, and still others climbing.

Skeletal muscles have the property of *plasticity*, and partial transformation of muscle fibers from one type into another can be observed in them, as a result of systematic training or following modulation of motoneuron activity [9, 13]. This transformation is interceded by calcium-mediated pathways that are associated with the involvement of calcineurin, calmodulin-dependent kinase, and the transcription cofactor PGC-1α. The transcription factors directly responsible for the reprogramming of the genes that regulate the specificity of metabolism and contractility of muscle fibers are the subject of intensive research. *Calcineurin,* for example, is a cyclosporine-sensitive and calcium-dependent protein phosphatase. It is necessary for the differentiation of myocytes and the formation of the slow-twitch muscle fibers. Its activation leads to up-regulation of the gene promoters responsible for the synthesis of the isoforms of the heavy chains of the myosin molecule, specific thereof.

There is ample evidence to suggest that the key to muscle plasticity is held by the family of genes responsible for the myosin molecule. Seven different gene variants exist, which allows a great variety of muscle composition. In theory, the contractile ability of muscle fibers is modified depending on the expression of various genes responsible for the heavy myosin chains. Most genes can be switched on and off by the indirect action of signaling molecules, such as hormones or growth factors. The adaptive changes in muscles as a response to training depend on the type of muscles applied during physical activity. It is considered that muscle genes are regulated primarily by mechanical and/or metabolic stimuli [8].

Stretching muscle fibers during outdoor recreation physical activity is one of the possible stimuli for adaptation. Passive stretching increases hypertrophy even in the absence of innervation, hormone action, and adequate nutrition [1]. The transmission of mechanical forces to nuclei and ribosomes can occur directly (via the cytoskeleton) or indirectly (via stretch-activated ion channels or stretch-activated adenylate cyclase).

The destruction of muscle cells as a result of strenuous physical exercise may also play a role in stimulating muscle hypertrophy. This occurs under the impact of released muscle-specific growth factors.

It is also suggested that the increased concentration of cAMP and the increased entry of metabolites into muscle cells stimulate the development of mitochondria as a result of training for endurance [14].

1.4 Endocrine adaptation in outdoor recreation physical activity

Together with the nervous system, the endocrine system integrates the physiological response in incidental physical exercise and plays an essential role in maintaining homeostasis. During physical activity, the plasma level of some hormones changes. This occurs as a result of the secretion of endocrine glands, the accelerated blood flow, the increased loss of water, and the subsequent hemoconcentration and also as a result of the reduced metabolism of the hormones in liver and the clearance of the end metabolites by the kidneys. The established changes are summarized in **Table 1**.

Growth hormone (hGH) increases its levels in the blood as a result of physical exercise and can reach levels 20–40 times higher than those at rest. The increase is more significant in untrained than in trained people [1]. In athletes, the increased concentration returns to initial values significantly faster than in untrained individuals. The importance of increased levels of the growth hormone in physical activity is explained by the subsequent facilitated entry of amino acids into cells and

Hormone	Response	Features	Importance
Catecholamines (adrenaline, noradrenaline)	Their plasma concentrations increase	Noradrenaline increases more than adrenaline	Blood glucose is increased; glycogenolysis in skeletal muscles and liver is increased; lipolysis is increased
Growth hormone (hGH)	Increased production	Increases substantially in untrained; drops more rapidly in trained individuals	It raises the level of anabolic processes in cells, including in muscles
Adrenocortico-tropic hormone (ACTH) → cortisol	Increased production	More significant increase in intense exercise; in submaximal exercise, they increase to a smaller extent	Gluconeogenesis in liver increases; mobilization of fatty acids increases
Thyroid stimulating hormone (TSH) → thyroxine	Increased production	Intensity of thyroxine transformation increases, with no toxic effect	Enhanced intensity of lipolysis
Insulin	Decreases the hormone production, due to increased glucose utilization	Drops the level of hormone after physical exercise (training)	Blood sugar level is regulated
Glucagon	Increases	Plasma level increases immediately after training	Increases blood glucose through glycogenolysis and gluconeogenesis
Renin-angiotensin-aldosterone (system)	Increases	With enhanced capacity after training	Retention of Na to keep the plasma volume
Antidiuretic hormone (ADH)	Increases		Retention of water to keep the plasma volume
Testosterone	Increases		Raises the levels of cellular protein anabolism and stimulates erythropoiesis

Table 1.
Endocrine response after single-bout of physical exercise.

their use in the process of protein anabolism (especially in muscles), as well as by hyperglycemia, which improves the conditions of energy supply.

Adrenocorticotropic hormone (ACTH) increases its levels as a result of physical work. This increases the activity of the adrenal cortex and results in glucose storage (glucocorticoids stimulate gluconeogenesis, the formation of glucose from noncarbohydrate sources, such as amino acids, lactate, and pyruvate), which is especially important during prolonged exercises. During physical work with a very long duration, both morphological and functional depletion of the adrenal cortex occur.

The increased tone of the sympathetic part of the autonomic nervous system during physical exercises causes an increase of the level of catecholamines in the blood. This is a result of both their increased secretion from the sympathetic endings and the stimulated adrenal medulla. The changes are of great functional importance associated with the body's adaptation to physical stress—cardiac output increases, as well as blood pressure, blood sugar levels, activity of lipolytic enzymes, and as a result, fats are mobilized from depots. The induced bronchodilation helps to increase pulmonary ventilation.

Androgens (testosterone) have an expressed anabolic effect on skeletal muscles. They increase bone density and stimulate erythropoiesis. Serum testosterone and the amount and binding capacity of androgen receptors in skeletal muscles transiently increase with physical exercises, and therefore they have a beneficial effect on the body's adaptation to physical exercise [15].

1.5 Thermoregulation in systematic outdoor recreation physical activity

Almost all the energy released during catabolic processes in the body is converted into heat. During exercise, 75–80% of the energy released from intracellular chemical reactions is transformed into such, ensuring the production of ATP necessary for muscle contractions. Much of the remaining energy, eventually, is also converted into heat (muscle contraction, friction of blood in the vessel walls, friction on joint surfaces, etc.). During physical work, the amount of heat produced by the muscles can be up to 60 higher than that at rest. To not overheat the body, in these cases, it is necessary to provide adequate heat loss, which under conditions of the most heat production can reach 1 kJ per second. The efficiency of heat transfer during physical work depends on the weather conditions under which it is performed. Radiation is the main mechanism for heat loss when the ambient temperature is lower than the body one. In sports practiced outdoors (running, cycling, rowing), convection has a bigger share in heat loss than that at rest. The share of evaporation depends on both the ambient temperature and the humidity. Physical activity is also accompanied by increased perspiration. At high temperature in environment and moist air, the mechanism of heat loss is greatly impeded.

Sweating is an essential thermoregulatory mechanism when performing physical work, the main one—at ambient temperature above 31°C, and the only one— at temperature above 34°C. The maximum amount of sweat released for 1 hour is 1.8 l. Such a discharge can be kept for 3–4 hours, after which it decreases in ongoing physical effort.

Overheating of the body occurs at high temperature and air humidity and low speed of wind. When working in an environment with the above characteristics, body temperature can rise up to 41–42°C, values to which brain cells are particularly sensitive. Weakening, headache, nausea, profuse sweating, confusion, and sometimes loss of consciousness occur. The combination of the above symptoms gives a picture of *heat stroke*. Even if physical work is stopped immediately, the temperature does not return to normal at once, because it itself accelerates the chemical processes in the cells and disrupts the precision of thermoregulation.

Systematic training provides better adaptation of thermoregulatory mechanisms and maintenance of stable isothermy, which is extremely important for high working capacity in the performance of muscle work, especially in conditions of overheating microclimate [16].

1.6 Electrolyte balance and acid-base balance in systematic outdoor recreation physical activity

The loss of body water during physical work can be significant. It is performed through sweating and *perspiratio insensibilis* (mainly because of the increased pulmonary ventilation). As mentioned, evaporation and sweating are thermoregulatory mechanisms that adapt the body to the increased heat production. However, with prolonged and intensive work, they can also have adverse effects on the body.

At high temperatures and humidity, 2–5 kg of body weight can be lost per hour (primarily at the expense of the released sweat). When sweating is so abundant that decrease of body weight becomes greater than 3%, there is a deterioration in performance indicators. In the case of rapid weight loss of 5–10%, muscle cramps, nausea, and vomiting occur, which requires medical intervention aimed at restoring the discharged fluids by infusion of replacement solutions [17].

Performing physical activity is accompanied by decreased urine production due to the decreased renal blood flow, the increased sympathetic tone, the increased secretion of antidiuretic hormone (ADH), and aldosterone. Meanwhile, the breakdown of muscle and liver glycogen produces metabolic water, the amount of which can reach up to 1–1.2 l in intense exercises where a complete depletion of glycogen stores occurs.

Due to the lower osmolarity of the discharged sweat in comparison with the plasma one, profuse sweating may cause *hyperosmolar dehydration*. Plasma amount decreases due to the total loss of water and the movement of water from the bloodstream to the interstitium, as a result of the increased concentration of osmotically active substances therein. This causes a significant hemoconcentration aggravated by the emptying of the blood depots. The hematocrit increases, and with it the internal resistance of the blood, which further impedes the work of the heart.

Increased sweating during physical activity is associated with a significant loss of electrolytes, including also of sodium. The intake of sodium chloride solutions during exercise at high temperature and humidity has an adverse effect on the body. The addition of salts to the water increases the osmolarity of the stomach contents, which slows down the emptying of the stomach and further aggravates the dehydration. The intake of hypertonic solutions suppresses sweating, which disrupts thermoregulation and thus encumbers the process of acclimatization to heat. Therefore, it is customary to give hypotonic fluids with little or no sodium to people who perform a prolonged physical work with profuse sweating. However, taking too much hypotonic fluids also has an adverse effect due to the developing hyponatremia and water intoxication.

Exposure to warm and humid climate while performing physical activity causes acclimatization of the sweat glands within 1–2 weeks due to the increased aldosterone secretion as a result of the increased activity of adrenal cortex. Aldosterone stimulates the reabsorption of sodium in the tubules of the sweat glands whereby its loss together with the sweat decreases. By contrast, the potassium excretion with urine and sweat increases.

The changes in the acid-base balance that occur while performing physical activity depend on its intensity and duration. A reduction of pH is observed, which is due to an increase in the plasma concentration of lactate and fatty acids. The normal plasma concentration of lactate at rest is within 0.7–1.6 mmol/l. During exercises of high intensity and duration, it can reach values above 15 mmol/l. To the extent that the plasma lactate is of metabolic origin, this condition is defined as *metabolic acidosis*.

The systematic practicing of outdoor recreation physical activity increases the adaptive capabilities of the mechanisms that maintain the electrolyte and acid-base balance in the body.

1.7 Immune and hemocoagulation response in systematic outdoor recreation physical activity

It is well-known that physical activity affects the body immune system. It is believed that submaximal exercise stimulates both nonspecific immunity and specific immunity, which reduces the risk of inflammatory diseases [18]. However, there are studies that evidence immunodepression induced by intense training and accompanied by increased infectious morbidity, especially by acute respiratory infections [19, 20].

It is predominantly thought that the *single-bout* exercise causes a decrease in immune reactivity, while the systematic, repeated submaximal exercise has a different effect on the indicators of immunity and of the systematic inflammatory response, respectively.

We conducted a study on 143 youngsters actively practicing rowing (14.01 ± 0.06 years; 56.35 ± 0.49 kg; 3.44 ± 0.06 years of sports experience, training twice, 5 days a week) and 61 untrained controls (14.12 ± 0.09 years; 57.01 ± 0.23 kg). We found that the average level of serum IgA in training individuals is by 47.5% higher ($P < 0.001$), that of IgM is by 22.0% lower ($P < 0.001$), and of IgG—by 10.7% higher ($P < 0.05$) than that of not training people [21].

In healthy people, physical activity and training also cause changes in hemostatic indicators. A single-bout exercise usually results in transient activation of the coagulation system, which is demonstrated by a shortening of the *activated partial thromboplastin time* (APTT) [22–24] or by activation of the fibrinolytic mechanisms [25]. There are few studies intended to explore the effect of long-term practicing of different types of physical exercise on coagulation. From our study conducted on 37 actively practicing submaximal exercise people (age—15.49 ± 2.02 years; 4.83 ± 2.20 years of physical activity) and compared to 67 controls of the same age (15.81 ± 2.73 years), no difference was found in the basal values of the main hemocoagulation indicators: *number of thrombocytes* (PLT), *fibrinogen* (FGN), *prothrombin time* (pT), *activated partial thromboplastin time* (APTT), and *thromboplastin time* (TT). By contrast, in people practicing anaerobic exercises for a longer time, these indicators evidence persisting, to a largely greater extent, activation of the hemocoagulation mechanisms, a thing which is typical of extreme exercise in untrained individuals [26].

1.8 Adaptation of oxygen transport in blood in systematic outdoor recreation physical activity

While practicing systematic and intensive exercises, changes occur, which affect the variables associated with the red blood cells. Many researchers even describe the so-called" *sports anemia*" in both athletes and experimental animals [27–29].

With our large-scale study conducted on 876 (559 boys and 317 girls) from sports schools, we aimed to analyze the variables of the red blood cells by sex and practiced sport discipline, as well as to compare them with the same indicators in 357 untrained youngsters (171 boys and 186 girls) [30]. The sporting students carried out training five times a week, 90 minute twice a day. The untrained students had a moderate physical activity performed in two training sessions, of 45 minute each week. It was found that the trained group has a significantly lower number of erythrocytes, hematocrit, and hemoglobin as compared to the control, untrained group.

The applied factor analysis showed that "sports practicing" has a strong impact on the values of these indicators ($P < 0.001$). The average values in the trained group were below the lower reference limit for the population of the same age [31, 32]. It turned out that active sports do not affect the average amount of erythrocytes.

Specific gender differences in performance were found between trained and untrained boys and girls. Trained boys had significantly lower values of the red blood cell count (by 6.14%), hematocrit (by 6.78%), and hemoglobin (by 7.21%) compared to the same indicators in untrained students, as the average values were lower than the reference for the same age. Similar results were obtained for the girls actively practicing sports. No differences in the mean corpuscular volume (MCV) between trained and untrained boys and girls were found.

A statistically significant effect of the type of practiced sports discipline by boys on the studied indicators was observed. For example, swimmers had a lower red blood cell count by 10.4% than that of the controls, rowers—by 7.5%, weight lifters—by 6.6%, practicing team sports—by 5%, wrestlers—by 4.4%, and track and field athletes—by 3.5%. In respect of hemoglobin concentration, swimmers had lower values by 13% than those of untrained students, wrestlers—by 7.8%, rowers—by 7.3%, weightlifters—by 4.2%, and practicing team sports—by 4.1%. In swimmers, lower hematocrit by 10.1% than that of the controls was found, in wrestlers—by 7.3%, in play sports—by 7%, and in rowers—by 6.2%.

In girls, the lowest values of the erythrocyte count were found with the rowers (by 4.4% below those of the untrained). The lowest value of hemoglobin was found with the rowers, practicing team sports, and swimmers.

Correlation analysis showed that in athletes, there is a relationship between sports experience and the reduction of the studied hematologic parameters. The highest degree of correlation in boys was found between the length of sports experience and the reduction in swimmers and rowers. In girls, such a high correlation was found in those practicing judo.

2. Outdoor recreation and prevention of socially important diseases

Socially important diseases include a large and diverse group of conditions that are characterized by high frequency, high cost of treatment, and rehabilitation and require specialized medical care. They affect a part of the population in active working age and lead to various complications and disability, and in addition, they have a high mortality rate and thus cause a serious economic damage to people. Psychological harm affects not only patients but also their loved ones. Some of the widely spread socially important diseases include some diseases of the cardiovascular system, metabolic diseases (obesity, metabolic syndrome, and diabetes), some mental illnesses, cancer, osteoporosis, etc. The increase in their frequency in recent decades is associated with a greatly neglected physical activity of the population, affecting increasingly younger groups of people. In this regard, given the above physiological adaptive effects of the increased outdoor recreation physical activity, the latter is a favorable preventive tool to reduce the risk of such diseases, and its practice would lead to significant medical and social benefits.

2.1 Cardiovascular diseases

Cardiovascular diseases are the leading cause of death in most countries around the world.

Arterial hypertension (AH) affects more than one billion people worldwide. It is a permanent increase in systolic and/or diastolic arterial blood pressure. Depending on the course and severity of AH, various complications develop, such as early atherosclerosis, ischemic heart disease, including myocardial infarction, renal disease, retinopathy, vascular disorders, etc.

A number of clinical and experimental studies evidence that the recreation physical exercise of the aerobic type can be used as a prevention or drug-free therapy for hypertension, as it has a hypotensive effect and favorably affects some of the cardiovascular risk factors (dyslipidemia, insulin resistance, obesity, etc.), resulting in a reduced risk of cardiovascular morbidity and mortality [33, 34]. One of the largest meta-analyses conducted so far shows that aerobic exercise in hypertensives reduces systolic pressure by about 5–10 mmHg but has almost no effect on diastolic arterial blood pressure [35]. Optimizing the duration, frequency, and intensity of the applied endurance exercise is of key importance for the effective reduction of high blood pressure. In patients, training with an intensity of 40–60% of VO_{2max}, 30–60 minute per day, 3–5 days a week, is recommended; however, the issue of exercise refinement is still not fully resolved [34–36].

Ischemic heart disease is due to the disparity between the volume of the coronary blood flow and the oxygen needs of the myocardium because of a change in the coronary blood flow. Some of the risk factors for the development of the disease include AH, dyslipidemia, smoking, diabetes, family history, increased body weight, mental stress, and last but not least—reduced physical activity.

A study of people with ischemic heart disease using coronary computed tomography angiography shows that regular, moderate to intense, exercises for endurance (three or more times a week, for 60 minutes or more) has a beneficial effect on the course of disease [37]. In US Preventive Services Task Force Recommendation Statement, 2017, it is recommended to maintain a healthy lifestyle and follow a balanced diet and appropriate physical activity for adults with cardiovascular risk factors and also for those without high cardiovascular risk [38]. The higher frequency of physical activity and aerobic training to increase the level of cardiorespiratory fitness leads to a reduction in the incidence and occurrence of complications of cardiovascular diseases [39].

2.2 Metabolic diseases

Obesity is most commonly defined as a condition with an increased body mass index over 30 (kg/m^2). Its frequency has been on the rise in recent decades. It is widespread in all countries and affects more and more children. Although it has a broad etiology (endocrine diseases, intake of medications due to other diseases, mental illnesses, genetic predisposition, etc.), the leading cause is an unbalanced diet and reduced physical activity. Obesity is associated with a high risk of developing type 2 diabetes, cardiovascular diseases, bronchial asthma, and cancer. It is perceived as a condition of chronic low-grade inflammation with all consequences thereof, and ultimately significantly deteriorates the lifestyle of those affected.

Type 2 diabetes is a metabolic disease, which is characterized by the development of insulin resistance. It occurs with disorders of the carbohydrate, protein, and fat metabolism. All systems and organs are affected, and the changes are mostly in the blood vessels and the nervous systems. It leads to serious, often irreversible complications.

Metabolic syndrome is defined as a combination of interrelated risk factors for the development of atherosclerotic cardiovascular diseases and type 2 diabetes. Its main components are abdominal obesity, atherogenic dyslipidemia, high blood pressure, and insulin resistance with/without impaired glucose tolerance. It is considered a proinflammatory and prothrombic condition. It is widely spread and has an increased mortality.

An integral part of the treatment of metabolic diseases is a change in lifestyle, including increased physical recreation activity. A study conducted on children shows that for just 12 weeks, the performance of one-hour outdoor physical activities, 3 or 2 times a week, reduces their body mass index and is a preventive measure against children's obesity. Physically active children in this study have increased their social–emotional wellness [40].

Research on the relationship between body mass index and total fat mass index, and some cardiometabolic parameters in young people—aged 10 and 18 years, evidences that higher total fat mass index and body mass index are associated with higher arterial blood pressure, higher plasma levels of very low-density lipoproteins, low-density lipoproteins, triglycerides, insulin, and lower levels of high-density lipoproteins. The same study also reported that body mass index and total fat mass index increased at the age of 18, which in turn was associated with higher values of glycoprotein acetyls [41].

2.3 Mental health

There is ample evidence that increased physical activity has a neuroprotective effect and can be used as a means to accelerate the recovery processes of both the peripheral and central nervous systems after nerve injuries, as well as to slow down neurodegenerative processes in the brain [42]. Outdoor recreational physical activity can induce endogenous neuroprotection by activating multiple mechanisms, such as promoting neurogenesis, improving the neurovascular unit integrity, decreasing apoptosis, and modulating inflammation.

Some studies have reported a correlation between the decreased neurotrophin production and diseases, such as depression, schizophrenia, and dementia [43]. Rodent models have shown that increased physical activity elevates the expression of the *brain-derived neurotrophic factor* (BDNF) in the hippocampal and cortical areas, and it has been related to the improvement of cognitive function, including memory [44]. Both acute, high-intensity activity and regular, moderate aerobic exercise have been reported to increase the levels of circulating neurotrophic factors and enhance neurotransmission, exerting beneficial effects on mood and cognitive functions in individuals of all ages. Additionally, increased physical activity promotes brain health by supporting the cerebrovasculature, sustaining the integrity of the blood-brain barrier, increasing glymphatic clearance and proteolytic degradation of amyloid beta species, and regulating microglia activation [45, 46].

In recent years, a number of data have been accumulated on the beneficial physiological and psychological effects of physical activity in epilepsy. Epilepsy is a socially important disease characterized by a persistent predisposition to generate epileptic seizures with neurobiological, cognitive, psychological, and social consequences. Systematic physical exercise, on one hand, reduces the severity and frequency of seizures, and on the other hand, raises the seizure threshold in both animal models with epilepsy [47, 48] and in clinical trials with epileptic patients [49]. Although the mechanisms are not fully explained, it is believed that due to its neuroprotective effect, physical exercise successfully counteracts harmful factors, such as distress, intoxication, degenerative changes, and circulatory disturbance, which can lead to seizures and impairment of cognitive functions in these patients [50]. Epilepsy itself and most of the antiepileptic medications impair the cognitive functions [51], which requires the search for methods that complement the basic therapy to reduce cognitive deficits. Our previous experimental studies have shown that the regular physical exercise reduces the cognitive deficit from the application of antiepileptic medications and suppresses depression and anxiety behavior in epilepsy [44, 51, 52].

The regular outdoor recreation physical activity improves the physical and mental condition of the individual, but data on the positive effect of physical exercise in epilepsy are still being clarified. This is one of the reasons for the health-care organizations to warn people with epilepsy to avoid certain types of physical exercise because of the potential risks of inducing seizures or injury [53]. Extreme sports are prohibited, such as some of the winter ones (snowboarding and extreme skiing), water sports (diving), freestyle (fencing and mountain biking), and in ball sports, head playing is not allowed.

A number of studies have noted a link between the level of physical activity and the severity of symptoms in depression and conditions of anxiety. A sedentary lifestyle is a prerequisite for deteriorating mental health, while physical exercise reduces the risk of developing these conditions [54–56]. Mental health prevention includes stimulating the population for increased physical activity, including outdoor recreation.

2.4 Others

Malignant diseases form a severe heterogenous group of diseases. The most commonly diagnosed are cancers of breast, colon and lungs. It is a worrying fact that in 2012 alone, 14 million new cases were registered worldwide [57, 58]. The frequency is expected to rise to 22 million newly registered annually over the next two decades [57]. This requires strengthening of preventive measures, such as visits to preventive examinations, avoidance of harmful habits, rational nutrition, maintaining optimal body weight, and increasing physical activity [58].

Osteoporosis is a disease characterized by deterioration of the microarchitecture of the bone tissue and a decrease in the mass of the bone stock, which leads to an increased risk of fractures. A number of factors determine bone mass: genetic, nutritional, bad habits, hormonal, intake of some medications, hypokinesia, immobilization, etc. There is strong evidence that physical activity in a “dose-dependent” manner slows down the loss of bone mass in postmenopausal women. The outdoor physical exercise in the form of recreation procedures can increase bone mineral density [59].

Timely and complex treatment of socially important diseases leads to their more favorable course delay or avoidance of the occurrence of complications, as well as to the better quality of life of patients. The prevention of these diseases would lead to an improvement in the health status of the population as well as a number of economic and social benefits. Undoubtedly, outdoor recreation physical activity is a part of the prevention of most noninfectious socially important diseases.

3. Take-home messages

Outdoor recreation physical activity is causing beneficial physiological changes in the body, which affect both the somatic and mental health. Adaptation changes concern cardiorespiratory, endocrine, nervous, and most of the other functional systems:

- It causes an increase of the activity of muscle oxidative enzymes in the pathway of carbohydrate, fat metabolism, and in the respiratory chain.
- Along with the increased muscle vascularization, the outdoor recreation physical activity is associated with partial muscle fiber transformation in submaximal trained muscle groups.
- A metabolic adaptation occurs due to the shift from carbohydrates to fats as a source of energy during exercise with a submaximal intensity with a following "glycogen-sparing" effect, which in turn delays the time to fatigue and increase physical endurance.
- Long-lasting changes in humoral immunity manifested by an increase of serum IgA and IgG levels occur as a result of outdoor recreation activity.
- Adaptation of the oxygen delivery system and of the mitochondrial oxygen utilization system is observed, which results in an increase of the maximal oxygen uptake (VO_{2max}) and economy of the oxygen utilization.
- The hormonal response to outdoor recreation physical activity is associated with better adaptation to physical stress and maintenance of homeostasis.
- Outdoor recreation physical activity is beneficial for prevention and treatment of socially important diseases, such as increased blood pressure, ischemic heart diseases, metabolic syndrome, diabetes type 2, etc.
- The increased outdoor physical activity has a neuroprotective effect. It can be used to accelerate the recovery process after nerve injuries, to slow down neurogenerative processes and have beneficial effects in epilepsy, depression, anxiety, and cognitive impairments.

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Chapter 3

Physiological Responses to Outdoor Recreation: How it Can Help you Prepare your Outdoor Activity and How to Intervene

Andrée-Anne Parent and Tegwen Gadais

Abstract

Outdoor activity can help to promote an active lifestyle; however, it is often associated with risks from its surrounding environment. Understanding physiological responses to several outdoor activities and how to use simple monitoring tips to reduce risks will provide real-life applications in the preparation of outdoor recreation. The purpose of this chapter focuses on common stressful conditions: thermoregulation, energy demand, musculoskeletal injuries risks, sleep and recovery. These are some constraints that can be encountered in any outdoor context. The physiological responses and recommendations based on up-to-date research will provide useful methods for risk assessment and how to manage them. Finally, the health benefits from outdoor activity in different populations will complete this chapter in order to help specialists structured and adapted their intervention planning.

Keywords: outdoor recreation, thermoregulation, metabolism, musculoskeletal injuries risks, recovery, physiology

1. Introduction

Outdoor activities have many health benefits, such as promoting physical activity and could play a role in stress management and mental health [1, 2]. However, the outdoor environment can be challenging for human physiology. Therefore, preparations are needed before the start of the activity in order to prevent any potential risks. The present chapter will outline the basics human physiological responses to different environmental challenges during outdoor activities and how to better prepare for them in the wild. Most of the research related to environmental physiology and guidelines in outdoor safety were conducted in work-related environments from different occupational health-related studies. This previous research could give us a better understanding of the physiological responses in the environment and may be used to prepare for outdoor activities. However, the physiological responses in a work-related environment could be different in the outdoors, and thus recommendations may have to be adapted for outdoor recreational activities. For this reason, the present chapter will include both work-related and outdoor-related physiological responses and guidelines.

2. Thermoregulation

Human body core temperature needs to stay in a short-range of approximately 37 ± 1° C [3]. During an outdoor event, the environment can impact the core temperature. Accordingly, wearing clothes, seeking shelter or exposure time will help keep the homeostasis of a core temperature between 27 and 42°C [4]. However, some outdoor sports involve risks related to cold exposure due to the distance from a shelter, and in turn, this could affect core temperature.

The environment influences human thermoregulation in different ways by four physics principles: radiation, conduction, evaporation and convection. The heat transfer from or to a human body with the environment is based on physics rules. Convection is a transfer of heat by fluid motion (gas or liquid) across the surface. Conduction is a heat transfer from a solid material to another through direct contact, for example, the hot sand on a beach to your feet. Radiation in the environment comes from the sun radiation, which is reflected from the ground or a rock. Nonetheless, the radiation can arise from the human skin that constantly radiates heat in all directions. This radiation can be observed with an infrared device and be used for safety in some work area where workers are exposed to high-temperature variations, such as a frozen food factory. Finally, evaporation is the primary way to dissipate heat from the human body. For example, sweat must evaporate (turn into a gas form) to dissipate the heat. In a situation where the sweat stays in liquid form, it represents a water loss without heat loss for the human body. The interactions between the environment and the human body are illustrated in **Figure 1**. Some equations are proposed to understand the thermoregulation resulting from these different factors interactions between the human and his environment: the heat balance equation:

$$M \pm R \pm C \pm K - E = 0 \tag{1}$$

M: metabolism (heat production in Kcal), R: radiation or radiant heat exchange (where the value is negative when the environment temperature is lower than the skin and can be measured with a globe thermometer or infrared), C: heat exchange by convection (where the value is negative when the air temperature is lower than

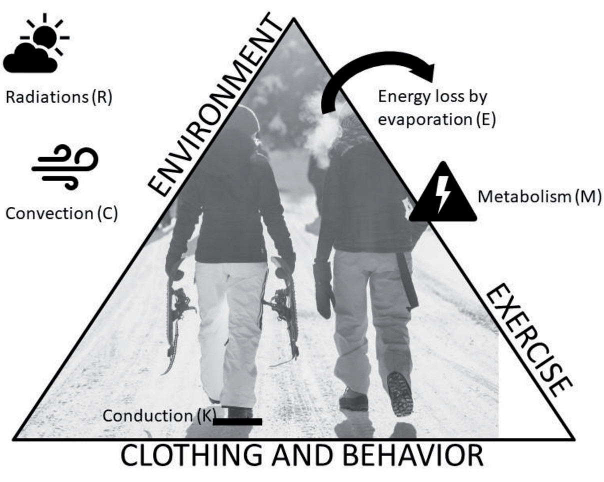

Figure 1.
Thermal balance between environmental factors as well as behavioral and physiological human responses.

skin temperature that can be measured by a thermometer and hot-wire anemometer), K: heat exchange by conduction (this value is usually negligible, except for activity like swimming or diving, K can be 20 times heat conductive (heat-removing in cold water) than air. Finally, E: heat loss by evaporation can be estimated by weight difference to estimate the sweat amount where some equations can help to convert in heat (energy) loss [5–8].

From this equation (Eq. (1)), other authors add some parameters: Gagge and Gonzalez [9] added work (+W) to the equation (Eq. (2)); work means any physical activity where a heat production will result from muscle activity. Winslow, Gaggeand, and Herrington [10] also proposed correction due to the storage of body heat (S). It was observed that most tissues are about 0.83. Even if all these equations are from old studies, they are the foundation of many guidelines for outdoor activities.

$$M \pm S \pm R \pm C \pm W - E = 0 \tag{2}$$

Some human behavior factors help humans to survive in an environment where the balance will be superior (core temperature increase) or inferior (core temperature decrease) at 0 in the equation's result. The 0 represent the thermal comfort, and to reach it, one of the planning of outdoor activity is clothing. It is also possible to calculate the thermal comfort from clothes in some environment with the Clo units [11]. One Clo unit represents the thermal isolation to maintain comfort and mean skin temperature at 33°C at rest in an environment with the air temperature of 21°C, relative humidity less than 50% and air velocity at 20 ft./min as defined by Gagge et al. [12]. This way to measure the impact of clothing still use today in occupational health and sports enthusiast [13, 14].

2.1 Physiological responses to a cold environment

A cold environment can affect a stable thermal balance by inducing physiological changes. Briefly, when the blood and/or the skin temperature decreases, the information goes to the hypothalamus to induce: 1) vasoconstriction in skin blood vessels to reduce heat loss in the environment and, 2) the skeletal muscles are activated to produce heat, causing the shivering. These responses help to increase heat production and in turn increase body temperature to keep homeostasis. These physiological changes are influenced by individual characteristics such as body composition, ethnicity, sex, age, and fitness levels [6]. But other factors could also affect these responses such as medication, caffeine and alcohol [15–17]. For example, consuming acetaminophen may decrease core temperature and heat production [18]. However, it should be noted that the physiological responses to a cold environment are complex and that the fundamental mechanisms involved in this process are poorly understood.

2.1.1 Effect of cold environment exposure on exercise performance

In a cold environment, the human body responds differently from an acute than repeated exposure to cold. During an acute exposure to cold, the skin receptors are responsible for alerting the human body by some discomfort. Usually, the human body begins to experience some discomfort at a skin temperature under 29°C. However, with acclimatization by repeated exposure to cold, a tolerance is developed partially by a psychological adaptation, by a central nervous system adaptation and lower finger skin temperature loss [19, 20]. During outdoor activity, this acclimatization can help motivate people to enjoy winter outdoor sports, but it can further increase the risk of cold injuries [19, 21].

During winter outdoor activity, other considerations need to be taken regarding energy intake and exercise performance. Metabolism increases 2-5 times by the sympathetic system at rest, but at exercise, it will depend on the intensity and can reach 10-20 times higher. For the moment, the literature is not consistent with the oxygen consumption at the same intensity in a cold environment. Some authors will report a higher oxygen consumption, and others reported a similar consumption [22]. These different results can be explained by different temperature expositions, the exercise intensity and, the participants' fitness levels [22, 23]. A similar controversy can be observed with the heart rate at submaximal exercise that can be explained by the exercise intensity. Oska et al. [23] observed that the heart rate was lower at the cold environment for a moderate exercise intensity (50%VO2max), but was higher during very light exercise intensity (25%VO2max). Nonetheless, the authors agreed on the decrease of maximal oxygen consumption and the decrease of maximal cardiorespiratory capacity [4, 22]. Finally, other physiological responses can affect exercise performance during outdoor activity in a cold environment such as: a decrease in strength, a decrease of maximal power, coordination lost a decrease of dexterity, higher reaction time and decision-making that can increase the accident risks for some sport like climbing [6, 8, 20].

2.1.2 Individual characteristics

Some individual characteristics need to be taken into consideration with the planning of outdoor activities. As mentioned earlier, body composition, ethnicity, sex, health status and age can influence the physiological responses to cold. Body fat percentage and the ratio body surface on body mass can affect the thermoregulation efficiency. That is, subcutaneous fat is an excellent insulator due to reduced conductor proprieties by the lower quantity of blood vessels and water. This creates an excellent resistance to heat exchange towards the environment in which individuals with higher fat percentage will conserve more heat in a cold environment. Skinfold measurements may be used as a clinical tool to quantify subcutaneous fat thickness and could be used as an indicator of tolerance to cold. The ratio body surface to body mass also influences the rate of heat loss. In fact, a larger individual with a smaller surface area will increase their tolerance to cold. These two anthropometric characteristics explain why older people, adolescents and children are more at risk than an adult. Usually, these populations have lower subcutaneous fat and a disadvantaged ratio. Furthermore, older individuals often have medication intake that can play a role in thermoregulation, and this may increase the risks in a cold environment [4]. Ethnicity can also influence thermoregulation responses. For example, research has shown that Caucasians have a different oxygen consumption, skin temperature and rectal temperature responses to acute cold exposure than African American [24]. These differences seem to be explained by several adaptation patterns (by genotypes and/or phenotype) across other various ethnicity groups such as Eskimos, Alacaluf Indians and Australian Aborigines [25].

For the sex influence, the estrogen secretion influences the hypothalamus where even if women have generally a higher percentage of body fat, they have a lower tolerance to cold and lower skin temperature for the same effort and same environmental conditions than men [26, 27]. This implies postmenopausal women have a higher cold tolerance than premenopausal women. It was also observed by Kaikaew and al. [26], that women will start shivering at a higher environmental temperature than men. This sex different should be taken into consideration during preparation and during outdoor activity.

2.1.3 Prevention and intervention tips

Frostbite and hypothermia can have important consequences, which include superficial tissue loss to loss of consciousness. The Wilderness Medical Society has provided some simple guidelines in a cold environment [28]:

- Be aware of any underlying factors that increase risks in a cold environment, such as medical problems like Raynaud's syndrome or diabetes, substance intakes like medication, alcohol or drugs that can decrease peripheral perfusion, individual's characteristic like age and sex;

- Bring spare dry clothes, mostly for the peripheral members (e.g., socks, mitts);

- Bring chemical or electric hand and foot warmers;

- Locate shelters during the activity if needed;

- Maintain hydration and energy needs. Exercise is a great way to produce heat, but the energy and hydration needs will increase too;

- Be careful of moisture from perspiration or activities in the snow; wet clothes increase heat loss;

- Minimize blood flow restriction such as tight clothing or footwear, backpack, and hiking carriers for babies;

- Verify regularly for pain/cold discomfort and numbness or venous return if possible.

2.2 Physiological responses to a heat environment

Physiological responses to high temperatures have the same goal as the cold environment: keep a body temperature balance inside the vital range. Similarly to cold temperature, when the core temperature increase the blood activate signals to the hypothalamus. These signals activate sweat glands in order to increase evaporation and vasodilation in the skin blood vessels to increase heat loss and regulate core temperature for homeostasis. Similarly to cold temperature, responses can be different from one individual to another regarding various characteristics such as ethnicity, sex or age. Furthermore, due to the changes in the blood flow by peripheral vasodilatation for sweating and the increase of cardiac output, medication uptake can affect the thermoregulation responses and increase hyperthermia risks. Another response to a warm environment is an increase in heart rate at rest and during exercise. People at risk using medication that affects cardiovascular parameters need to be supervised closely and carefully.

2.2.1 Hydration and guidelines in a hot environment

The thermoregulation needed in a hot environment increases metabolism and sweat, while hydration and energy/mineral uptake can be a challenge due to this higher need [13, 29, 30]. Some guidelines in occupational health propose to drink around 0.23-0.25 L of cold water every 15-20 min [31]. Other authors are more precise like the US Army table, in which water intake is adapted according to the following factors: temperature, activity intensity and duration. The guidelines vary from 3.8 cups/hour at over 90°F WBGT (wet-bulb globe temperature index) for 10 min of hard work (600 W) to 1.9 cup/hour for an unlimited time at easy work (250 W) at 78-81.9°F WBGT [32]. Nonetheless the guidelines you follow, drink content should also be taken into consideration due to risks of hyponatremia. Plasma sodium can rapidly drop below 130 mmol/L during high-intensity exercise in a hot environment. It is for this reason, the ACSM recommends to drink during exercise over 2% of body weight loss from water deficit and after exercise consuming meals, snacks and beverages with sodium to help the recovery [33]. To help you plan the need of hydration, occupational health Institution, like the IRSST (Institut de recherche Robert-Sauvé en Santé Sécurité au Travail) proposed calculators in their website to plan rest, activities, hydration and other recommendations to reduce risks in a hot environment. It should be noted that these recommendations are specific to workers, thus, they may not be appropriate for all outdoor activities.

2.2.2 Acclimation in a hot environment

Acclimation to heat at exercise can be done with different varieties of frequency, intensity, duration, and environmental temperature. Adaptation time varies between 4 and 14 days [34–36]. This acclimation needs to be maintained to keep performance capacities (submaximal performance, VO_2max and power). The acclimatization induced a higher and more sustained (decrease sodium and chloride concentrations) sweat rate when needed and improve thermal comfort [30, 34]. Also, the physiological acclimation from repeated exposure to heat induces an increase in sweating and skin blood flow responses, a plasma volume extension, a better fluid balance, better cardiovascular stability (a lowered heart rate but higher stoke volume to induce a better sustained cardiac output and blood pressure), and a lower metabolic rate [30, 34]. All these acclimations help sustain activities in heat environment with a better tolerance, a lesser need for minerals and better sweat evaporation. These acclimations can stay up to a month [37].

2.2.3 Individual factors that can influence thermoregulation in a hot environment

Like the cold environment (**Figure 2**), individual characteristics can play a role in the thermoregulation response. The sex will contribute to some variations. Women will have a body temperature that will fluctuate about 0.5-0.8°Celsius during her menstruation cycle, and the progesterone and estrogen levels with oral contraceptives can influence the thermoregulatory control of skin blood flow and body temperature during physical activity and rest [27]. Furthermore, women have lower sweating rates than men for the same heat loss demand (metabolic demand and environmental temperature) at high temperature (40°Celsius) [38]. Finally, age, genetic and % body fat can influence the thermoregulation in a heated environment for a similar reason as explain for cold exposure. It is for this reason; the individual's characteristics need to be taken into consideration during the outdoor activity preparation.

2.2.4 Prevention and intervention tips

Heat environment should be avoided if possible. If the context is impossible to control, it is essential to prepare consequently by having enough water and heat

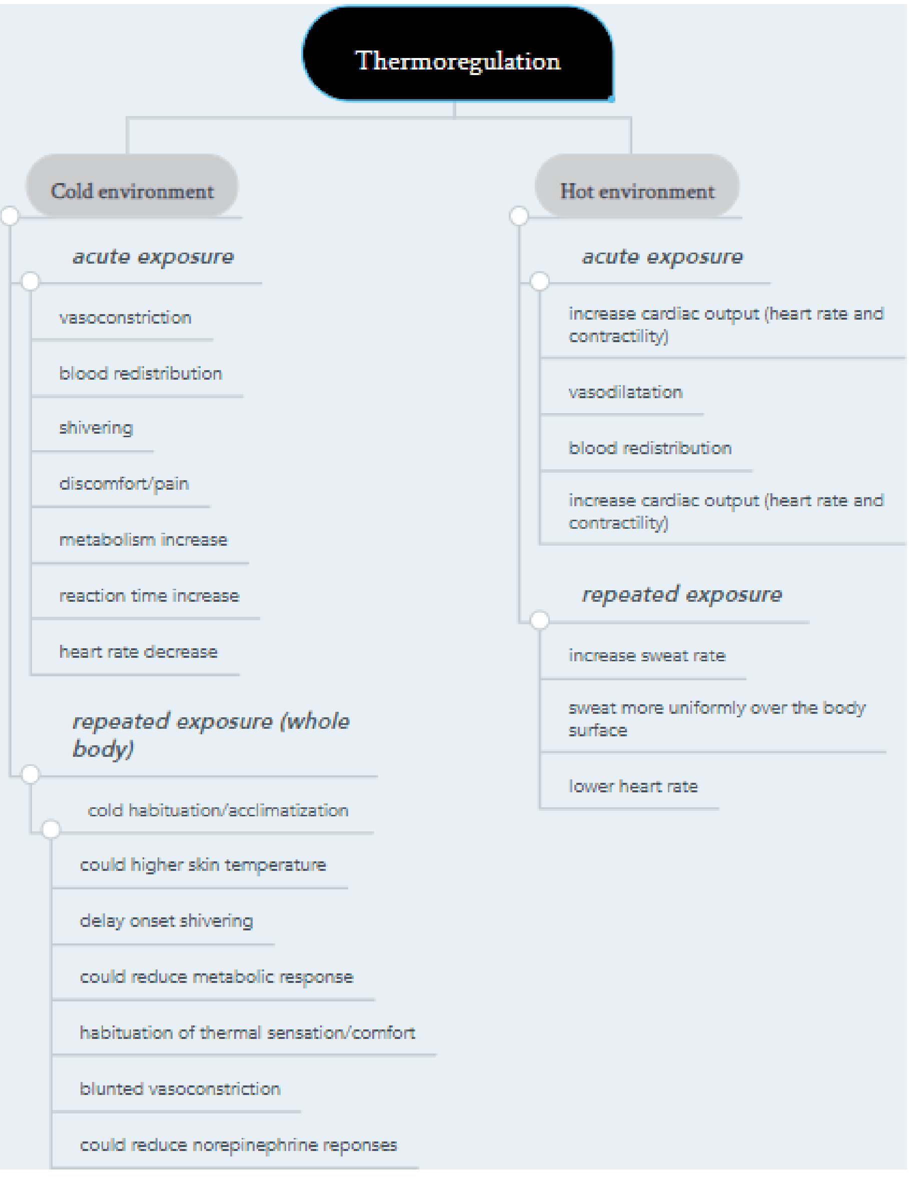

Figure 2.
Summary of physiological responses to thermoregulation during acute and repeated exposures (cold and hot environment).

acclimatize to the participant in the outdoor activity. Do not forget that thermal stress relies on multiple factors such as sex, age, ethnicity, anthropometry, substance intake, and health history.

Hyperthermia and other heat-related illnesses can have important consequences, from heat, cramps to heatstroke. The Wilderness Medical Society provided some simple guidelines in heat environment [39]:

- Be aware of any underlying factors that increase risks in heat environment, such as medical problems high blood pressure, substance intakes like medication (beta-blockers, amphetamines…), alcohol or drugs, individual's characteristic like age and sex;

- Bring enough water or plan where to refill your bottle, hydrate before during and after the activity, the hydration status is an high-risk factor;
- Promote acclimatization: 8 days, 1-2 h per day heat exposure and regular physical activity before the outdoor event if it plans to be in a heated environment;
- Use WBGT (wet-bulb globe temperature index) temperature to assess the heat risks;
- Wearing the right clothing for the right temperature.

3. Altitude and physiological responses

The challenge to climb high mountains and enjoy the view from the summit is probably an outdoor activity goal for many hikers. Altitude environment could drastically challenge human physiology, where appetite, sleep, cardiorespiratory responses and metabolism are affected. Some physiological responses can be affected as low as 1000 m above sea level (a.s.l.) and begin to decrease performance around 2000 m a.s.l. [40]. During hiking ascent, the barometric pressure decreases and the partial pressure of oxygen (PO_2) in the arterial from the cardiorespiratory system too. This lower pressure affects the O_2 diffusion between alveoli and the arterial blood, and between the arterial blood with the tissues like the muscles. This lower oxygen diffusion in blood arteries and consequently, a decrease of oxygen saturation can be monitored with a pulse oximeter device. An immediate adjustment during the initial rise will be the activation by chemoreceptor in the aortic arch and carotid arteries, stimulated by hypoxia (low PO_2), inducing a ventilation increase to compensate [41, 42]. A few hours later, plasma volume decreases frequently due to water loss through ventilation and increase of urine production [43]. This change increases the hemoglobin concentration in the blood flow, increasing the oxygen exchanges to the muscles. After a few hours in altitude, the erythropoietin (EPO) will increase the release by the renal system. The EPO regulates the red blood cell production and increases the blood hemoglobin concentration further. Also, the cardiac output (the function of the heart rate X stroke volume) will increase during rest and exercise; due to the plasma decrease (decrease of cardiac stroke volume). The heart rate will disproportionately increase [43, 44]. This increasing cardiac output, consequently, increases the blood pressure, and people at risks should be monitored for safety. The amount of fluid loss can be a challenge to stay hydrated during ascent; a general rule is to consume at least 3 L of fluid by day in high altitude [7]. The physiological responses to altitude and susceptibility to altitude illness vary between individual, this explains why monitoring often during rising will help you to recognize normal responses to abnormal responses.

Between 1850 m and 5895 m, some people (22-77% of travelers) can experience acute mountain sickness (AMS) [43]. This sickness includes headaches with one or more of the following symptoms: vomiting, lethargy, nausea, loss of appetite, insomnia but with a normal mental status [40, 43]. Usually, around 80% of individuals experiencing AMS will resolve their symptoms when stopping ascension and resting at the current altitude for 2-7 days [45]. Be aware, more severe altitude illness can occur and can be fatal if not treated in time, like the High-Altitude Cerebral Edema or the High-Altitude Pulmonary edema, where monitoring your group is vital for their safety.

3.1 Physiological response acclimatization and risk during a long expedition in altitude

Human physiology responses acclimate to altitude exposure from a few days to weeks. Some changes help humans to perform at high altitude. These physiological changes should, theoretically, improve O_2 transport to the active muscles during exercise, and it is why athlete use altitude training acclimatization to improve their performance [42, 46]. However, some individuals can be affected differently during the acclimatization period when exercising. The maximal aerobic capacity decreases in altitude and by consequence, the exercise intensity will need to decrease too at the beginning of the acclimatization process. Basal metabolic rate will increase, but appetite decreases, which can lead to a daily energy deficit that can affect exercise tolerance and, during long expeditions, muscle mass loss [7, 40, 47]. Furthermore, many individuals experience sleep disturbances and/or sleep apnea; the hypoxia can induce central sleep apnea and affect people at risk of cardiovascular disease [41, 48]. Moreover, sleep is important to recover and perform hiking during the long ascent and can affect the time and performance during long expedition in altitude. Finally, after 4-6 weeks at high elevation, climbers can experience a decrease in total mass area, a capillary density decrease, mitochondrial dysfunction and a decrease in glycolytic activity, which can impact their capacities [40, 44]. However, some other acclimatization will help exercise tolerance after a few days to some weeks, depending on individuals [42, 49]. Cardiac output and peripheric blood flow will return to normal, reducing cardiac work and improving the diffusion time for oxygen extraction by tissues [49]. Also, continuous residence in altitude improves exercise tolerance compared to initial exposition [42].

3.2 Prevention and intervention tips

Hiking in altitude environment can be a beautiful outdoor recreational activity with great landscape pictures opportunities. However, preparing this kind of activity will need to consider long periods of rest and acclimatization and regularly to monitor your group.

Altitude is a challenging environment and can have consequences, from mild headaches to fatal altitude illness. The scientific literature provides some simple guidelines to prevent altitude illness [42, 43, 50]:

- Prepare a slow and gradual ascent, a general recommendation is a daily ascent around 500 m altitude gain including a night's sleep, with an extra acclimatization day every 1000 m;

- Using Acetazolamide or Dexamethasone can prevent AMS, but can have side effects and have limits to considerate;

- The descent is the best treatment for acute altitude illness, prepare plans if some people need to return at normobaric environment quickly;

- Use different tools to assess and monitor your group: Lake Louise AMS score [51] and pulse oximeter devices;

- If you can provide repeated exposure to hypoxia (normobaric or hypobaric) before your excursion or spending a week at moderate altitude (2200 m-3000 m) before exposure to high altitude, this can improve exercise tolerance and decrease risks of AMS;

- Plan enough water and food, knowing that altitude will increase your needs.

4. Workload, sleep and recovery process

4.1 Physiological risk to load

Outdoor activity can be a repetitive action like walking for hikers or rowing for canoes. Repetitive movement for a long period of time increases the risk of musculoskeletal injuries [52]. Musculoskeletal injuries are multifactorial; some authors have proposed underling hypotheses [53]. During repetitive motion some motor units in the muscles are recruited continuously, they are called the Cinderella fibers, increasing risks of injuries by a sustained contraction for a long period of time [52–54]. Other mechanisms like neural pathomechanisms, reperfusion injures, impaired heat shock responses and mitochondrial damages was also proposed to explain musculoskeletal injuries in repetitive workload (Forbes 2002). Rest and changing the activity (movement) can help to reduce the risks, ergonomic papers propose to plan sufficient rest to avoid injuries [55]. It is for this reason; rest time and recovery need to be planned for this kind of activity. Even if it can be difficult to use occupational health guidelines for rest, outdoor activities should plan regularly rest time and changing movement if possible in order to avoid musculoskeletal injuries.

4.2 Hiking workload

Hiking energy cost will depend on many factors such as the load, the slope, the environmental conditions, the surfaces, the clothing and footwear and the individual capacities. Walking velocity has an impact on energy expenditure and fatigue; individuals have their own threshold where running would be more cost-effective than walking and will naturally shift from walking to running when it is more cost-efficient. This speed is usually around 7 km/h [56]. The slope impact on this energy cost was introduced as a concept of mechanical efficiency by Margaria [57]. This means you will need to assess your group to find the more effective speed or separate your group in subgroups consequently.

Furthermore, the physical workload can be planned to prevent fatigue. Usually, occupational studies recommend (eight hours a day, all week) that physical demands should be in a range of 33-50% of VO2max. However, backpack weight, altitude, temperature, and distances to travel during hiking expeditions can easily overtake this guideline. It is for this reason, allow enough rest period, assess the group mood and perception. The backpack choice (padded hip belt, size, fitting on the shoulder…) and load weight and his distribution are factors that can influence your participant's risks relative to their capacity [58]. Among the risks, dorsal back pain, knee pain, rucksack paralysis, stress fractures, low back injuries, metatarsalgia and foot blisters were reported in the literature [58, 59]. The hip belt suggests a more natural movement and stability at the hip, but factors like walking velocity, body weight and posture, hip-belt size, distribution and weight of the load in a backpack in the function of the participant center of mass position can affect the hip belt [59]. Furthermore, shifting load from shoulder to hip decrease discomfort and decrease load impact on the spine by decreasing risks of low back pain or injury [60]. Another reason to be careful with the shoulder forces is the macrovascular and microvascular hemodynamic that can be compromised and lead to neurological dysfunction and probably a loss of hands fine motor control [61] and consequently possibly increase frostbite risk in cold environment.

4.3 Physiological responses during sleep and recovery

Fatigue means different things for different individuals. In sports medicine, fatigue is often quantified by a decrement in muscular performance to produce force with/or perception of tiredness or pain [62–64]. Many factors can contribute to fatigue such as the intensity, the duration and the nature of the activity, the sex and individual capacities, but also the equipment used [62–64]. Rest induces physiological changes after exercise to improve physical capacities, however; improper recovery may cause residual fatigue, where systematic, can cause overload and increase injury risks, overtraining syndrome or decrease physical performance [65]. Fatigue is often separate as peripheric fatigue, from the muscle capacity (i.e., energy production, contractile mechanism) and central fatigue, from the central nervous system [65]. To reduce risk, plan your activity intensity progressively and according to the individuals or group capacity. If possible, plans an outdoor training before a longer expedition to build higher capacity and decrease the rest needed to recover.

Quality of sleep can be impacted by outdoor environments like altitude and temperature. Furthermore, altitude can cause central sleep apnea, insomnia, pulmonary or brain edema during sleep [66]. Sleep deprivation can impact your outdoor activities by a decrease of capacities, fatigue perception and even bad mood [66, 67]. However, the natural environment can also increase sleep quality for some individuals due to the light pollution and the physical activity (melatonin regulation). Light pollution and lack of exposition to natural light can impact sleep circadian rhythm [68]. The natural environment exposure can influence sleep quality positively by regulating melatonin secretion, reducing artificial light exposure, promoting exercise and reduce some city noises [69].

4.4 Prevention and intervention tips

Load and repetitive movements can increase musculoskeletal injuries risks. The scientific literature provides some simple guidelines to prevent some risks [54, 63]:

- Decrease the load as much as possible and increase physiological capacity before a long hiking journey;
- Plan many rest breaks during your activity;
- Change activity or movement if possible after repetitive tasks like walking or canoeing.

5. Nautical activities and physiological responses

5.1 Water safety

Marine activities can be an outdoor activity with some specific risks to avoid. Epidemiology articles have examined some typical injuries for different nautical sports. Twenty six percent of injuries from wakeboarding involved the head, back and ribs [70], and surfing and water skiing reported many cases of craniomaxillofacial laceration [71]. These injuries are only some example of dangers beyond drowning.

Water safety and aquatic recreation precaution are not always well understood. Moran and Ferner [72] reported that New Zealand residents and tourist surfers had a poor understanding of rip current (powerful and narrow channels, seaward flowing current along gulf, coast, beach and lakes), which is that can frequently occurring hazard. Rip current are also responsible of rescues and drowning with many swimmers, where public education and awareness strategies need to be implement in your activity preparation [73]. Lack of awareness of alcohol consumption and downing risk was also reported as a major safety problem in aquatic activities [74, 75]. From fatal and non-fatal drowning, an average of 49.5% and 34.9% respectively involved alcohol consumption [74]. This lack of understanding and knowledge dangers can also arise from marine envenomation, where tourists are often not aware of venomous creatures like starfish, sea urchins and stingrays [76]. These can also include infectious water area, where pathogens can contaminate the swimmer, surfer, or another nautical activity practitioner. One of these infectious diseases contracted in water is the Legionellosis disease, a severe bacterial infection with similar symptoms of pneumonia; this pathogen can be found in freshwater, natural water or artificial water and some cases were reported in Greece among hotels [76]. Finally, decompression illness (DCI) is probably the most common risk for an unexperimented diver. During DCI, microbubbles are formed by the nitrogen during an inadequate decompression in tissues and intravascular, damaging blood vessel (including pulmonary circulation), distorting tissues and initiate inflammatory response [76, 77]. Most of these risks are the result of lack of knowledge and/or awareness and could be prevented by a proper preparation: wearing the appropriate safety equipment, all practitioner should have proper training and education of the activity and the environment and having adequate communication tools for emergency situation.

5.2 Seasickness

Seasickness is a form of motion sickness, a common physiological response to unnatural motion stimuli where the vestibular system (semi-circular canals and otoliths) information from linear (mostly vertical) or angular acceleration of the head mismatching the eyes signals [78, 79]. This conflict can cause nausea, vomiting, cold sweating, pallor, dizziness, drowsiness and headache [80]. Seasickness can affect up to 25% of passengers on a large ship and will increase with a smaller boat and bad weather conditions [81]. Individual difference susceptibility can be difficult to predict who will have seasickness. However, a questionnaire *the Motion sickness susceptibility questionnaire* (MSSQ) and the short MSSQ can help to identify some people that could be susceptible to seasickness [82]. Furthermore, children aged 6-12 years old, women and lack of sleep can contribute to higher susceptibility to seasickness [81–83].

Exposure to motion environment (water) can gradually help prevent motion sickness. Accordingly, a few (1-3) days on a boat is usually enough to acclimatize depending on the individual [80, 81, 84]. The following recommendations [84] should help if you have an individual in your group with seasickness:

- Ask the passenger(s) with seasickness to look forward at a fixed point on the horizon and not close their eyes;

- If possible, gradually increase the number of motion stimuli, start the travel in calm waters;

- The passengers with seasickness should avoid close work (cooking, read inside, looking at computer...), avoid space without the horizon view, avoid alcoholic drink, and an empty stomach (eat before traveling);

- If the passage can actively synchronize the body with the motion;
- The passenger with seasickness should change their mind, like listen to music;
- Use a motion sickness susceptibility questionnaire to plan your activity in consequence; for example, people susceptible to seasickness could take medication, like scopolamine, before traveling combine to behavioral strategies (above).

6. Conclusion and future research

Outdoor activities need some preparation to decrease risks for the participants. Knowledge of physiological responses may help better understand the principal preparation tasks and risks that can occur during outdoor activities. However, some physiological mechanisms remain unknown, and some are controversial, thus, more research is needed to fully understand human physiology in an outdoor environment and propose better prevention tools and guidelines. Furthermore, there is evidence to suggest that natural environment activities are associated with health benefits, but the mechanisms still not fully understood [85].

One of these health benefits is that outdoor activities can increase physical activity time [85–87], that can help decrease cardiovascular disease, metabolic complications and some cancer risks and improve physical capacity [88]. In a society where physical inactivity and sedentarily time is a major health problem, like sitting at a desk for long hours, outdoor recreative activities can be beneficial even for a short bout like walking in a park during breaks [88–90]. Furthermore, several studies have observed the positive effects of nature on health, stress and recovery [85–87]. This exposure to nature, even from a picture, could promote recovery and restore stress levels [91]. To conclude, all these benefits can help society and promote outdoor activities and green spaces. Also, further research is needed to better understand the underlying pathways of these benefits. Moreover, specific guidelines for the outdoor reality are needed in order to provide tools for outdoor professionals.

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Conflict of interest

The authors declare no conflict of interest.

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Chapter 4

Outdoor Recreation within the School Setting: A Physiological and Psychological Exploration

Brendon Patrick Hyndman and Shirley Wyver

Abstract

School recess is a crucial outdoor recreation period to develop health behaviours such as physical activity, social and thinking skills that can track into adulthood. As students in some schools can be immersed in playground recreation opportunities via up to 4200 school breaks during their schooling (three times per day, 5 days per week, 39 weeks per year, 7 years of primary school), the school playground has become an emerging focus for researchers to facilitate important health outcomes. Outdoor recreation activities during school recess can contribute up to half of a child's recommended physical activity participation. Ensuring there is an enhanced understanding and awareness of what can enhance or hinder outdoor recreation activities within school contexts is therefore important to develop both physical and psychological strategies to help promote sustainable health outcomes. Despite outdoor recreation during school recess periods being a vital setting to develop physical, social and cognitive habits, the possibilities during this period have only started to gain momentum in the first two decades of the twenty-first century. This chapter will outline the important link between school playgrounds for outdoor recreation during school recess and the various physiological and psychological effects that have been revealed from various strategies that have been implemented for children with typical and atypical development.

Keywords: school playgrounds, recess, physical activity, psychological wellbeing, health

1. Introduction

Schools are widely acknowledged as a vital setting to develop a child's physical activity participation [1], with a comprehensive review from over 25 years discovering the positive links between a child attending school and participating in greater levels of physical activity [2]. Not only is the school context where children spend the majority of their time each week (+ 30 hours in many cases), but the school is also a resource full of outdoor recreational options for children to develop physical activity, cognitive and social habits. Such outdoor recreational pursuits could include non-curricular (e.g., after school, active transportation), co-curricular recreational opportunities (via recess, school sporting carnivals) and curricular programs (via outdoor learning/recreational programs). The importance of these outdoor recreational settings in school become underscored by the continual reductions in the ability of children to experience opportunities to play around the home and neighbourhoods (e.g., concerns of neighbourhood safety, pollution, restrictions and non-play values at home) [3, 4]. Moreover, it is vital that a child experiences a multitude of opportunities to be physically active during school recreation to meet national activity guidelines. International guidelines recommend children participate in 1 hour of moderate to vigorous physical activity (e.g., activity which makes you sweat and puff) to develop positive physical activity habits to protect against chronic diseases such as Type 2 diabetes, cardiovascular disease and osteoporosis [5].

In addition to the physical benefits that can be derived from outdoor recreational strategies within schools, research over the past two decades continues to unveil the interconnections between both the body and the mind [6]. For example, Santrock [7] makes the statement "biological processes can influence cognitive processes and vice versa … we are talking about the development of an integrated individual with a mind and body that are interdependent" (p. 16). The brain is one of the busiest organs in the human body by processing around one fifth of the body's metabolism during cognitive processes. Therefore, it should be no surprise that cognitive processes require a steady stream of oxygen and energy from physical activities to meet such mental demands [8] and why sedentary pursuits of sitting/standing should be avoided to ensure that mental demands are optimally catered for [9]. So if a child is undertaking vigorous outdoor recreational pursuits at school, it is expected that a child's capacity to be able to remember, perceive, concentrate and attend to academic tasks should be improved [6].

This chapter will begin by discussing how children can be physiologically effected from outdoor recreation in schools. The discussion will commence with an exploration of both structured (e.g., a set purpose, location) and unstructured (e.g., less pre-determined purpose) playground strategies during school recess. The discussion continues with exploration into before- and after-school outdoor recreational strategies that have been introduced to influence school children's physical activity participation and development. The next section considers the psychological context of recess, before detailing the specific and intersecting dimensions of children's cognitive and social development during outdoor recreation in schools. Finally, an overview is provided with key insights that have emerged from the literature in relation to the physiological and psychological effects that have been measured within outdoor recreational school contexts.

2. Physiological effects from outdoor recreation in schools

The provision of a catalogue of outdoor recreational opportunities in schools is vital to ensure that children develop healthy habits and strong minds to take with them into both adolescence and adulthood [1, 10]. The impact and level of quality of earlier life experiences in physical and recreational pursuits often tracks into adulthood [11, 12]. Despite physical activity options being required to be delivered in various capacities of the school system, research continues to recognise that children will engage or prefer to engage in more sedentary-type behaviours of sitting and standing [13]. Large proportions of children exceed national screen time recommendations [14] and not meeting child physical activity guidelines has become the norm across most countries worldwide [15, 16]. For instance, a major international report on adolescent physical activity participation from decades of population data revealed that in most countries, just one (lowest) or two (highest) out of 5 children will meet national physical activity guidelines [17]. These guidelines are designed to ensure children are optimally healthy to prevent disease.

Despite such dire health results, there has been continual research to try and promote positive outdoor recreational strategies in schools to have an impact on school children's physical activities. With the positive links of physical activity participation on biological improvements well established [18, 19], most research focusing on the physiological effects from outdoor recreation in schools has been concerned with improving physical activity levels [20].

2.1 School playground recreational strategies to develop school children's physical skills and habits

The school playground during recess is a powerful outdoor recreational school context to enhance children's physical abilities. The school playground has a combination of supervision, access and safety which allows wide ranging physical activities for children [10]. In many jurisdictions, the school playground during recess time has become the main option for children's physical activity participation, as PE time allocations have been reduced and eradicated [21]. Earlier work researching the impact of children engaging in school playgrounds during recess has suggested that almost half of a child's daily physical activity is sourced from the school playground [22]. The importance of discovering customisable strategies within the school playground recreational context is therefore vital.

There have been a number of strategies trialled within school playgrounds during recess to improve outdoor recreational activity levels such as themed activity weeks, providing games equipment, loose parts, surface markings, fitness ideas and providing more natural features [20]. Most of these strategies have been successful on participation levels from short-term measurements, which is likely due to the novelty of introducing new strategies compared to constant playground agendas and the desire from the children to expand their play options with variety [10]. Themed activity weeks of having alternating weeks with an obstacle course, frisbee activities, fitness circuits and a week with normal activities is one of the playground intervention packages mentioned [23]. This alternating recreational strategy unveiled that physical activity participation levels were greatest during the two weeks in which the children participated in a fitness themed week or their normal playground activities. Fitness-focused playgrounds during recess have also had a positive impact on children's physical activity levels compared to recess periods with no set playground agenda being implemented [24]. The implementation of games equipment with providing activity details and instructions for a range of games and activities for the children to perform in the school playground has also been introduced. Scholars discovered that providing the game cards increased the physical activity levels in the school children [25]. The implementation of other recreational games have also had success on children's physical activity levels such as via interactive bowling and running games [26], alongside games offered by trained staff in recreational sports [27] such as in softball, tag, basketball and relay games. The painting of school surfaces with markings [28–31] to encourage the outdoor recreational pursuits with jumping lines, board games, agility snakes and hopscotch have seen the physical benefits of energy expenditure increases (can help with obesity), duration engaged in physical activity, improved compliance with national physical activity guidelines and overall increases in the intensity of a child's physical activity participation over a 2 year period. Moreover, combining a range of strategies such as training staff to facilitate children's activities within the school playground, breaking up the playground into activity zones (e.g., soccer, tag games) and the introduction of loose sporting equipment (e.g., balls, markers) have had a positive impact on the intensities children's engaged in their outdoor recreational activities at school [32]. Additionally, even the simple redesign of playgrounds for outdoor recreation with equipment such as climbing structures, slides, and a spinning apparatus have had a positive impact on children's physical activity levels [33] or reducing sedentary behaviour [34].

Less structured recreational strategies without a set location, time or purpose have been found to have quite holistic benefits on children's physical health. For instance, these strategies have simply involved getting rid of school playground rules/regulation, providing more natural features (such as rocks, trees, gardens) and implementing sparable, movable household items known as loose parts. Although not directly measuring physical activity participation, a New Zealand primary school principal reported on the amount of new physical activities taking place for children's physical development when he removed excess school playground rules and regulations [35, 36]. The Principal described how the allowance of play which was perceived as more risky unlocked a variety of physical activities such as climbing structures like hand rails and trees, skating across hard surfaced areas and sliding in the mud. Moreover, the Principal noticed a dramatic reduction in physical injury from providing more play freedom. The recreational pursuit of climbing can have a multitude of benefits on a developing child, including muscular strength, endurance and flexibility [37]. Although tree climbing is perceived by many as being risky [38], the introduction of features such as trees, rocks, gardens and grass areas has seen school children vary their outdoor recreational physical activities, enhance the amount of space and opportunities for physical activity, play freedom and have had an impact on moderate levels of children's physical activity [39–41]. By greening outdoor recreational areas in schools, the ability to improve children's self-reported wellness is also enhanced [42, 43].

Overcoming adult perceptions of risky play [44] also reignited a multitude of larger studies on the provision of loose parts on children's physical development. Most of this more modern research stemmed from Bundy and colleagues' pilot study [44] research which recognised that adults perceived loose parts materials (e.g., sticks, crates, hay bales) as too risky, yet the findings demonstrated the entire opposite in very young children. The loose parts were able to transform the school playgrounds into rich childhood developmental hubs via outdoor recreation and reigniting the momentum of loose parts from the 1970's [45]. The resulting physical activity outcomes from introducing loose parts have seen increases in primary school children's (of a range of year levels) physical activity enjoyment, intensities, steps/distance, activity types, playability, durations, complexity and many of these physical activity developments were sustained for long-term follow-up studies (e.g., 1–2½ years) [20]. The earlier findings were also supported by studies across other locations such as the United Kingdom [46] and New Zealand [47] with positive teacher reports of similar developments. Moreover, "relocatable" sports equipment are also reported to have positive effects on children's physical activity [48].

2.2 Before and after-school recreational strategies to develop school children's physical skills and habits

By investigating the school playground strategies above, it becomes clear that continuing to consider strategies which will not burden teachers' curricular commitments can be powerful on a child's physical development. It is also vital to consider a holistic approach to outdoor recreation during school days for children's physical development with additional strategies, particularly with curricular physical activity opportunities being constrained [49]. Beyond the school playground, the most prevalent outdoor recreation school avenues are through after school programs, school camps/excursions, and active transport (to and from school via movement).

After school programs typically involve collaboration between the community and the school. Internationally, there have been a number of extracurricular recreational programs, commonly focused on increasing physical activity through sports. For instance, in Hungary, physical education teachers coordinate and organise physical activities outside of school as a formal requirement [50]. In Taiwan, there are opportunities for children to connect, learn from and interact with adults from training institutions in how to undertake and participate in sports [51]. The Australian Sporting Schools program has been a significant recreational strategy introduced to schools which has been intended to increase children's participation in local sport with the delivery of programs by a national sporting organisation [52]. Whilst many of the after-school and extracurricular programs which are implemented worldwide have little research data showcasing program effectiveness, the reach of the Sporting Schools program from 4000 [53] to almost 7500 schools [54] nationwide shows some impact of the program.

Although much of the research of this chapter showcases programs to develop school children's health via outdoor recreational strategies within the school setting, it should be acknowledged that there has been some research with school children outside of schools. Summer camps for instance are highly popular in places such as Canada and the USA with large summer breaks [55]. Such camps can offer chances for outdoor recreational activities in areas of sport and adventure and have been identified as having a positive impact on school children's physical health [56], physical activity levels and meeting daily physical activity recommendations [57, 58]. Another outdoor recreational pursuit for school children is to walk or ride to school via active transportation [59]. Scholars describe active transportation as creating important physical activity habits in school children, environmentally friendly travel habits and a valuable opportunity to invigorate children's physical activity participation rates and levels [60, 61]. Although scholars caution school communities about potential safety risks such as road traffic and strangers, it is acknowledged internationally that school communities can consider programs such as a walking school bus concept in which adults lead a group of children [62, 63]. This can be achieved by considering stakeholder partnerships and the level of infrastructure and resources around a school's transportation networks to actively transport to and from school. Although this extra-curricular strategy to encourage physical activity has widespread support, there still remains a gap in the data relating to long-term insights and standardised outcome measures of physical activity [64, 65]. As detailed earlier in the chapter, if physical activity levels can be increased, this can also have a positive impact on the flow of nutrients to the brain to enhance cognitive performance. In the next section of this chapter, we unpack a range of the outdoor recreational strategies in schools which have had an impact on psychological functioning.

3. Psychological effects from outdoor recreation in schools

We begin this next section by considering the psychological context of recess before moving to specific areas of cognitive and social development. The psychological context of outdoor recreation in schools is rarely acknowledged, yet can be a major contributor to cognitive and social outcomes. One way to consider the psychological context is in terms of structure versus autonomy (e.g., ensuring more choice in how things are done). Structure can be imposed in a variety of ways including clearly articulated rules negotiated with children through to non-negotiable top-down rules or quick decisions by teachers on duty during recess regarding the rule boundaries and positive or negative play [66]. An increase in banning of activities that children consider to be fun has been found in a large UK study [67] and is likely to extend to other countries given the heightened concern expressed by teachers about risky play during recess [44, 68]. Teachers often face the dilemma of allowing children more autonomy or acting in accordance with their perceived duty of care which can involve imposing excessive rules and safety requirements.

Structure has sometimes been introduced as a means of increasing physical activity. There is speculation that an emphasis on sports and other structured physical activity can change the social hierarchy of the playground, elevating the status of children with better physical skills [69]. It is possible that high levels of structure to achieve physical activity outcomes may have a negative impact on children's autonomous decision making and social interaction processes. With less choices and opportunities for decision making during play, children suggest such restriction can cause boredom, misbehaviours (and injury) and a desire to lash out during school recess periods [70].

Many researchers and teachers argue that children need more elements of choice from the psychological component of autonomy to learn life skills. It is known that recess times are some the best times to offer such opportunities with minimum structure or intervention. As noted previously, loose parts have been offered to children during recess as a means of promoting physical activity through imaginative play. One of the adult-perceived difficulties with loose parts play is the potential for accidents and injuries. Interestingly, both parents [71] and teachers [72] seem to have a lower tolerance for risky play when a child has a disability. Interventions involving loose parts have helped to overcome many of the concerns related to risky play. Some interventions have included risk-reframing workshops to support shifts in thinking of teachers and parents about risks in play [73]. Interventions without these workshops have also succeeded in shifting adult behaviour from enforcing playground rules to granting children greater autonomy to make decisions about their play [47]. Hyndman and colleagues discovered that the introduction of loose parts can help facilitate outdoor school recreation activities which aligned with both national curriculum objectives [74] and key criterions of creativity [75]. This was achieved by encouraging children to learn and undertake more complexity with their recess activities with loose parts equipment. Loose parts have also been reported by teachers to have a positive impact on children's cognitive engagement during outdoor recreation activities [76] with impacts on short-term enjoyment levels [77], a key psychosocial influence for sustained participation.

Other interventions have provided more explicit play goals, but these have been negotiated with school personnel and children. The Health Active Peaceful Playgrounds for Youth (HAPPY) intervention [78] is an example of this type of approach. Some children were offered specific training relating to physical activity and social inclusion with peers. Children in this study were found to value clear rules for games that were known to all children. It is perhaps the arbitrariness of rules in some contexts that causes difficulties for children. For example, a staff member in one of the loose parts studies [46] mentioned that prior to the introduction of loose parts, children were held back by having to remember the recess rules. Emerging evidence also suggests that psychological benefits may be amplified if recess occurs in natural environments. This is mainly due to the stress-reductions experienced by children when in nature [79].

Some of the research questions regarding cognition and academic skills are relatively standard and relate to the possibility that recess provides a context for promotion and development of these skills. Surprisingly, some researchers are also interested in a null result, showing no effect. The reason for the latter interest is that time spent in recess is often perceived as time that could be better spent on direct instruction on academic tasks. Current evidence indicates that school recess does not have a negative impact and may have a positive impact in some areas of cognition and academic achievement.

There are sound reasons to believe that short-term or habitual physical activity will promote cognitive skills with a flow-on effect to academic skills. Children's enjoyment of more vigorous recreation activities during school recess has also been linked to improved quality of life [80]. Nonetheless, results have not been as clear as expected. Recent systematic reviews [81, 82] have shown mixed results and have called for high quality studies to address this question.

Physical activity in adults has been found to promote higher order cognition known as executive functions (EF). The core EFs are working memory, inhibitory control and cognitive flexibility [83]. Performance on EF tasks is predictive of academic performance [84]. Working memory involves holding and manipulating information in memory, such as when solving mental arithmetic problems. Inhibitory control is the ability to suppress a prepotent response. In academic work, the first response that comes to mind may not be the correct one and inability to suppress competing responses may interfere with task completion. Cognitive flexibility involves the ability to shift strategies when the one used becomes unproductive. A strategy may be effective in solving simple problems, for example, but no longer works when problems become more complex. Inability to change strategy makes it difficult to progress to higher level school work.

The EFs are known to be quite malleable during childhood. Researchers have therefore attempted to understand the mechanisms that support improvements in EFs. Physical activity has been identified as a potential contributor to brain plasticity, neurogenesis and resilience to damage. This is achieved through processes such as promoting blood vessel growth that support the brain's increased energy needs [85]. Research studies have not had a clear focus on recess, physical activity and EFs. Studies that might help understand the outdoor recreation in schools, physical activity and EF relationship have not always taken place during outdoor recreation in schools. For example, the FITKids randomised controlled trial [86] took place after school, but included games, teaching of skills and other challenges that could be available during outdoor recreation in schools. The FITKids trial was conducted with 7–9 year olds, with the intervention group showing improvements in two core EFS, inhibition and flexibility. This continues to be a promising area of investigation and more studies are needed. Current systematic reviews indicate that the results of studies are mixed, but importantly no studies show a decline in EFs following increased in physical activity [87–89].

Mathematics and literacy are the most common academic areas investigated by researchers. Time spent in physical activity during recess has not been found to adversely impact academic performance [15]. This has been demonstrated in a range of studies including a large cross-sectional Spanish study with 1780 participants aged 6–18 years [90]. There are also studies that have found a positive impact of physical activity on academic skills. A recent meta-analysis of 26 studies with participants aged 4–13 years found physical activity to lead to improvements in mathematics, reading and classroom behaviour. Mathematics was also found to improve in a recess study with Grades 3–5 involving exergaming [91]. Children in this study participated in "Dance-Dance-Revolution" (DDR), which involved aerobic activity and choreographed footwork and was appealing to the participants in the study.

One hypothesis regarding the mixed findings for EFs and academic performance is that physical activity alone is not enough to promote cognitive or academic development. What is needed is the addition of cognitive or social demands [88]. For example, DDR placed pressure on memory for the choreographed steps. It is also important to note that these interventions were offered during some recess sessions (e.g., DDR was 90 minutes per week), but children also had access to free play time.

To our knowledge there are no high-quality studies of unstructured recess interventions and EFs or academic outcomes. There is potential for future research as some researchers argue that structured activity during recess may interfere with academic performance, particularly for younger children who may need a break to during recess to reduce interference with preceding and following class instruction [89].

4. The social-psychological intersections of outdoor recreation in schools

For many children, school recess is the only opportunity to engage in peer activities with minimal adult supervision. Ideally, school recess offers opportunities for children to practice social interaction skills, negotiate with others to achieve goals, form enduring friendships, support peers experiencing difficulties and learn to manage their own risk-taking behaviours. Although social time on the playground may appear to be nothing more than a break from class, the quality and quantity of social time may have important implications for psychosocial development and academic achievement. For young children, level of social interaction with peers has been found to be positively associated with academic achievement whereas level of social interaction with teachers was negatively associated [92].

Social interactions are often different for girls and boys during outdoor recess. Girls have been reported to have higher levels of enjoyment for social and imaginative play [93], alongside more time in pretend play which requires planning with peers. Boys are more likely to engage in rough and tumble play, particularly in the early school years. Rough and tumble generally involves play fighting, wrestling and other behaviours that are sometimes mistaken for aggression [66]. Rough and tumble is therefore often banned or restricted on school playgrounds. Rough and tumble is developmentally important for the development of self-control, conflict resolution and affiliation. It is a positive behavior for most children with the exception of boys with a "rejected" sociometric status for whom it can predict antisocial behaviours. It is important to note that the gender differences observed during outdoor recess in western schools may not be universal. For example, there is evidence that rough and tumble play occurs equally for both genders in forager societies [94].

The majority of school children look forward to recess time and see it as an opportunity to engage in fun activities with friends. For a significant minority of children however, recess is a time when they are isolated, rejected or bullied. Elementary school children have nominated outside recess as particularly problematic for bullying [95]. Recess should offer an opportunity to promote psychosocial development, but this is currently not true for all children. Many of the issues that contribute to negative social outcomes are the same as those that contribute to social outcomes, including poor supervision, lack of materials and lack of space [96].

Some of the difficulties children have on outdoor school playgrounds relate to the spaces available. Children typically have the choice of large open spaces that are easy for adult surveillance or seeking privacy behind buildings where they may feel vulnerable. A recent study has shown that many children prefer "in-between" spaces for at least some of their outdoor play [97]. These spaces include under staircases, under trees and edges of buildings. Importantly, these spaces maintained a visual line to the main play areas and therefore did not incur the vulnerabilities of being out-of-sight. Some children said they worried about the boisterous play on the main playground. The in-between spaces meant they were less likely to be hit by a ball or knocked over by another child. Children also used these spaces for imaginative play or to define boundaries such as goal posts. In-between spaces provided greater opportunities for children to self-select their play and define their peer groups. Unfortunately, these spaces were often considered to be out-of-bounds.

Difficulties for children can stem from underlying psychological problems. Children with internalising or externalising disorders may have difficulties with social interactions on the playground. In recent years, social skills interventions have targeted peer interactions on the playground to support children's access to a complex social environment and with the goal of achieving the flow-on effect of improved academic outcomes [98].

Unfortunately, recess is often perceived as a privilege rather than an essential part of the school day. Consequently, there is a widespread practice of restricting or removing recess privileges from students for misbehaviour or to catch up on schoolwork [67]. Recess restriction continues to be a recommended behaviour management technique [99]. When asked, children indicate a preference for longer recess periods [67, 100]. Clearly, recess is valued by children which makes it an easy target for disciplinary practices. Children from third and fifth grade in two US schools indicated that they understood the reasons for teachers restricting outdoor recess, but largely considered it unfair and argued that it exacerbates antisocial behaviour for some children [100]. The children in this study valued the autonomy experienced during recess which included being able to run around and talk to peers about their chosen topics.

Loose parts play during outdoor recess has been hypothesised to have a positive impact on social interaction and social skills [101]. There are many reports from teachers to indicate that children's play is more cooperative and more inclusive when loose parts are introduced [76, 102]. A recent systematic review of loose parts play interventions found that high quality studies have not demonstrated significant changes in children's social competence and social skills [103]. One of the issues is that children in these studies may already be functioning well in terms of social competence and social skills [104]. This assumption is reinforced by social play often generating extremely high levels of enjoyment for children compared to other play categories [93, 105]. More research is needed to determine if children with poor social skills make improvements when negotiating with others in loose parts play and if fewer children are rejected or neglected during loose parts play.

Understanding of social development outcomes related to outdoor recess remains under-researched. There is criticism that the strong claims from authoritative organisations about the benefits of recess for social development have not been matched by strong evidence [106]. At a minimum, the current evidence suggests that outdoor recess has little impact on the social development for the majority of children. Recess is valued by children as autonomous time to spend with peers and provides teachers with opportunities to observe children's abilities to manage risks and negotiate with peers to achieve complex goals.

5. Conclusion

With the increasing burdens facing teachers (curriculum demands, professional development, student engagement/inclusion and workload intensification), it is more important than ever to ensure that there are quality outdoor recreational opportunities provided for school children. The chapter has detailed how the outdoor recreation setting during school recess is having an impact on children's physiological and psychological outcomes. Interestingly, it is clear that due to well-known biological benefits of physical activity on the human body, most physiological research investigating outdoor recreation in schools has simply focused on how to increase physical activity participation. Although a focus on participation levels is important to help children meet physical activity guidelines in order to prevent lifestyle diseases such as Type 2 diabetes, cardiovascular disease and osteoporosis. Yet what this chapter also uncovers is the strong interlinking nature between the physical, psychological and social outcomes of health. There were clear overlaps and insights gained between investigations across health dimensions. It becomes clear that the substantial amount of time children will be exposed to during "critical windows" of recess time in schools is vital to develop positive and holistic behavioural habits. Further investigations into school recreational contexts have the potential to continue to shed light on the developmental potential and possibilities that could be achieved for outdoor school recreational settings to be prioritised and protected into the future. There are numerous key messages from this chapter. First, it is the important to maintain or extend children's opportunities for outdoor recreation during recess due to the physiological and psychological benefits of extended outdoor interactions with peers. Second, allowing time for high quality outdoor recreation during recess does not interfere with academic outcomes. Third, many changes to school playgrounds, such as introduction of loose parts, are effective in bringing about change without adding to teacher workload. Finally, children look forward to outdoor recreation during recess, it improves their overall school experience.

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Chapter 5

Introducing Park Facilities and Novelties to Support Individual's Intention to (Re)Visit

Marija Opačak

Abstract

Many developed countries have recognized the importance of public parks in sustainable development of cities as they help minimizing the negative impact of urbanization. Developing countries, on the other hand, are facing problems such as lack of public awareness and inadequate facilities for sports and social activities to attract visitors to public parks, which positively affect the social and psychological human well-being. Parks are venues that enable people of all age groups to engage in different activities with family and friends and connect with nature. While planning a city development, policy makers should consider new findings in the area of brownfield regeneration, to use the existing land more efficiently and ensure public acceptance of the proposed projects. This chapter contains five sections. Section 1 gives an introduction to land use challenges faced by policy makers, brownfield sites, and stimulus that motivate people to use public parks. In Section 2, the importance of urban parks to human health and key elements to achieve urban sustainability are presented. Section 3 introduces novelty among park facilities. Section 4 gives an example of a landfill-to-park transformation. Section 5 summarizes policy suggestions for decision makers to increase their focus on the importance of parks.

Keywords: greenery areas, physical health, environment, recreation, novel park facilities

1. Introduction

Managing land represents a big challenge for city planners and policy makers, for instance, in India [1, 2], Vietnam [3], Sri Lanka [4], Australia [5], Germany [6], Japan [7], and South Africa [8]. Given the current course and future tendency in increasingly dynamic urbanized areas that are facing the lack of buildable land, the orientation is expected to shift towards the existing surfaces, which includes brownfields. The definition of a brownfield is found in Public Law 107–118 (H.R. 2869): "The term 'brownfield site' means real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties protects the environment, reduces blight, and takes development pressures off greenspaces and working lands" [9].

According to the brownfield regeneration approach and urban planning development, for instance, old landfills can be converted into useful sites at the end of their functional life since landfills are conveniently located near major transportation routes and other major infrastructure in urban areas. In such a situation, alternative landfill conversions are possible, including but not limited to building parks, solar panels, residential buildings, malls, golf courses, dirt BMX bike tracks, or combined development [10, 11].

According to the literature, policy makers are suggested to organize environmental education programs [12] and make extensive improvements in facilities for higher satisfaction of visitors [13]. Numerous examples demonstrate successful conversions of old landfills (**Table 1**) into recreational parks, such as Flushing Meadows (New York, USA), Mt. Trashmore (Virginia, USA), Freshkills Park (New York, USA), Cesar Chavez Park (Berkley, USA), Sai Tso Wan Recreation Ground (Hong Kong), Pulau Semakau (Singapore), Port Sunlight River Park (Birkenhead, UK), Hiriya Park (Tel-Aviv, Israel), and so forth. Thus, it seems that the option of building recreational parks after closing old municipal landfills could prove to be a promising measure, based on previous research literature on the redevelopment potentials of landfills [14–17] and the making of urban green space strategies [18, 19].

It is very possible that in modern dense urban areas, former landfills may end up being the only available, large, and open locations to build new public parks.

Landfill site	Existing and proposed afteruse
Shuen Wan	A 145-bay golf driving range has been opened for use by the public since April 1999. For details, please click Golf Driving Range at Shuen Wan. The development of golf course is being planned
Sai Tso Wan	Sai Tso Wan Recreation Ground for soccer and baseball. For details, please click Sai Tso Wan Recreation Ground
Gin Drinkers Bay	The Hong Kong Jockey Club International BMX Park situated on the Gin Drinkers Bay Landfill was opened in October 2009. For details, please click Hong Kong Jockey Club International BMX Park. Another portion of the site has been allocated to the Hong Kong Cricket Association for development of temporary cricket grounds
Jordan Valley	Jordan Valley Park was opened to public in August 2010
	The Park is featured with a radio-controlled model car racing circuit, horticultural education center, community garden, children's play areas, elderly exercise corner, jogging track, etc. For details, please click Jordan Valley Park
Ngau Chi Wan	Ngau Chi Wan Park was fully opened to public in Sept 2010 (its first phase opened in Aug 2009). The Park is featured with archery field, jogging trail, elderly fitness corners, children's play areas, basketball court, etc. For details, please click Ngau Chi Wan Park
Ma Yau Tong Central	Part of the site adjacent to the existing Lam Tin Park has been developed into a sitting-out area in January 2011
Ma Yau Tong West	Part of the site has been developed into a sitting-out area in September 2011
Tseung Kwan O Stage I	Waterfront of the former Tseung Kwan O Stage I Landfill was developed into a cycle track cum footpath and was opened to the public in June 2012
Tseung Kwan O Stage II/III	In 2005, top platform of the former Tseung Kwan O Stage Stage II/III Landfill had been developed into a model airplane training field for the Hong Kong Air Cadet Crops to use during weekends and public holidays. It is now used as a training field of unmanned aerial vehicle for land surveying
Pillar Point Valley	Part of the site has been developed into a shooting range in July 2016
Ma Tso Lung	For recreational use by Tung Wah Group of Hospitals
Siu Lang Shui	Currently as green zone
Ngau Tam Mei	Currently as green zone

Table 1.
Examples of alternative landfill reuse scenarios.

Their conversions present a great opportunity to correct the negative perception of dumps and the incessant patterns of environmental injustice. There are around 500,000 landfills in Europe [20], with the number of landfill sites increasing constantly. Therefore, they present a huge future potential, and their afteruse plan should be taken into consideration.

Ten percent of the total waste generated in the European Union is municipal, and 23% of the generated municipal solid waste was landfilled, a practice being particularly popular in SE Europe [21]. Twelve countries landfill almost half of their municipal waste: Malta, Greece, Cyprus, Romania, Croatia, Latvia, Slovakia, Bulgaria, Spain, Hungary, Czech Republic, and Portugal. With new policies and technologies, old landfills can be turned into beautiful sceneries, renewable energy, and building materials. Burying rubbish and keeping it in the ground represent environmental and financial cost. The land can be successfully reused, and waste can be mined for metals used to create fuel for use in cars, homes, or industrial plants. The problem of land reuse used to be technology, but now it is the lack of knowledge, which created fear among the people. Landfill conversions are generally unfavorably perceived, as many people are fearful that the local environment and quality of life will be negatively affected. As this fear is based on emotional rather than scientific information, research is expected to play a crucial role in educating people to support land recovery projects in the future.

Since residential development cannot take place for longer period due to the possibility of gas escaping (which is safe as long as they are not in confined spaces), using the municipal waste landfill site for recreational purposes is recommended. Parks as leisure services look for ways to differentiate themselves through the creation of their physical surroundings to attract visitors and stimulate repeated visitations. In order to succeed, regular refreshing of the facilities is required [22], which represents a huge financial burden for park owners. Therefore, renewal schemes based on objective rather than subjective assessments should be employed. According to empirical results, the higher the level of shopping values, the stronger their intention to revisit [23]. In that sense, it is suggested to introduce distinctive attributes in new parks that will be recognized as improvements and thus stimulate visitations. The conclusions of this chapter were based on the relevant literature key components of the surroundings and how customers perceive it.

2. Urban parks

Urban parks are a valuable municipal source of and a key element for city sustainability, as they are able to facilitate proper land resource allocation for citizens so as to meet their recreational demands and play other social functions as well [24]. They are fundamental to social and psychological well-being of city residents [25]. It has been proven that staying in urban greenery areas, like parks and forests, has positive and restorative effects on people's mood, peacefulness, concentration, and stress release [26–30]. Urban parks contribute to the beautification of the city and have positive effects on environmental quality, including air freshness, carbon sequestration, water purity, as well as biodiversity. They thus improve city dwellers' overall quality of life in areas including physical health, social cohesion, tourism, and consequently employment and revenues [18, 31–34]. Furthermore, green spaces can act as leisure, sport, and recreational resources, reducing criminal and antisocial behavior as well as cutting down on obesity, since such spaces encourage physical fitness and exercise [35–38].

Parks as facility-driven leisure venues look for ways to differentiate themselves through the creation of their physical surroundings. According to empirical results, park visitors perceive physical surroundings as novel. The higher the level of shopping values, the stronger their intention to revisit. In that sense, it is suggested to introduce distinctive attributes in new recreational venues that will be recognized as improvements and thus stimulate visitations (e.g., giant slide, graffiti, swings, tree-lined path, BMX tracks, skate bowl).

2.1 Urban sustainability

Due to the global climate change, sustainable management became one of the key elements to achieve urban sustainability. The most recent findings in the field of waste management [39–45] were collected and summarized in a list of challenges that policy makers should take into consideration:

- Technical integration and social acceptability are the critical aspects that advance municipal solid waste (MSW) management.
- Novel technology to be implemented.
- Environmental educational programs, actions, and projects to boost virtuous circle.
- Developing a culture of environmental protection.
- Integrated waste management has the best environmental impact.
- Zero-waste circular economy perception.
- Important role of waste pickers.
- Life cycle methods for decision-making improvement.
- Regulatory pressures to enhance smart waste management.
- Different locations/cities focus on different frameworks when dealing with specific environmental concerns.
- Social issue discovered to be the main factor that reduces MSW management sustainability.

The aforementioned challenges/suggestions were drawn from studies that dealt with the concept of solid waste. The term “solid waste” implies all the waste which excludes liquid residues and airborne emissions [46, 47]. Given the different location of landfills around the world and the corresponding geoclimatic and technological characteristics, we acknowledge that a MSW management pattern to follow does not exist. However, if similar conditions are met, policies can be replicated or used as benchmarks.

3. Novelty among park facilities

To perceive a product as new, an observer has to experience a certain level of change to his present knowledge. In that sense, radically new and incrementally new can be distinguished, where the first one involves a revolutionary change to present knowledge and the latter only a minor improvement or adjustment to present knowledge [48]. When there is a perceptible difference between the old and the new, the absolute threshold of newness occurs. For it to be evident, the initial stimulus must be stronger than the subsequent one [49]. Recognizing the extent to which novelty is incorporated within a service from the consumer point of view can assist parks owners, investors, or administration avoid unsound assumptions, especially in terms of how innovative the consumer perceives a product or a service and, based on that, makes his decision. It is important to point out that the newness and novelty arise from the observer or from products and services [50] that have to hold a new dimension relative to previous or other products/services, for example, a new roller coaster, a painted wall, or a new entrance gate.

In terms of atmospherics, the most commonly used model is Bitner's servicescape model with three dimensions of physical surroundings: ambient conditions, space/function, and signs, symbols and artifacts [51]. However, in the case of leisure "built environments" like parks, being renewable and visible are the necessary components of physical surroundings [52]. Wakefield and Blodgett suggested five dimensions to assess the impact of physical components of the servicescape on consumer behavior in leisure environment (sport stadiums, recreation centers, and theaters). They are as follows: facility esthetics, spatial layout and placement, seating comfort, electronic equipment and display, and cleanliness. As suggested by the same authors, (theme) park managers may consider regular renewals of physical surroundings by adjusting the esthetic of the facility and layout and placement to intensify visitor perceptions of the quality of the physical surrounding.

To describe visitor perceptions of park physical surroundings, researchers of consumption experiences commonly use the term "shopping values" [53], with utilitarian and hedonic perspectives [54]. If a service has a utilitarian value, it is essentially goal-oriented and functional, and the utilitarian value is determined when the consumption need is realized, which stimulated the shopping in the first place. Services with hedonic value, on the other hand, are more subjective and personal, experiential, and symbolic, and they arouse fun and excitement [55].

The consumer can positively and negatively react to the surroundings. When it comes to leisure service facilities, the consumer will experience greater satisfaction when the surrounding aspects (e.g., decoration and architecture) convey a higher esthetic sense. To measure the perception of the newness of physical surroundings for repeat visitors, the physical surroundings should be perceptible, have gone through renovation, and capable of renewal, and the novelty should be visible [23].

4. Landfill-to-park transformation: An example of Jakuševec landfill in Zagreb, Croatia

Croatia faced the issue of land reuse recently while considering closure and transformation of Jakuševec-Prudinec landfill (hereinafter Jakuševec) in Zagreb (**Figure 1**). The suggestions of land use alternatives for the particular site are related to leisure services that encourage physical fitness and exercise [56].

The closure of Jakuševec was announced years ago and had been spurring on residents' dissatisfaction ever since, in particular, the dissatisfaction of residents living in the immediate vicinity of the site. The management of the landfill, orchestrated by a city-owned company named ZGOS Ltd., carried out landfill remediation in 2003 and suggested December 31, 2018, as the starting date for waste disposal cessation processes [57]. The Jakuševec landfill was established in 1965 and has gradually led to significant negative environmental impacts on its surrounding regions. Statistical surveys indicate that just up to the beginning of the 1990s, the

Figure 1.
Study site location and the layout of Zagreb. Source: Geoportal of the state geodetic Administration of the Republic of Croatia, 2018.

landfill has occupied and polluted almost 1 million m3 of soil (soil material) and seriously jeopardized the quality of groundwater intended for drinking [58]. The groundwater pollution line has been spreading eastward, particularly in times of changing hydrodynamic conditions in the aquifer, which further increases concern among the citizens.

This is one of the seldom case studies in developing and small countries such as Croatia that supports brownfield regeneration, a new sustainable urban development planning method that functions by proposing a land use transformation based on a nonmarket valuation (NMV) method. This study addresses several questions based on a conducted survey, where the visitor's intention to visit recreational parks in the future is one of them. Similar to Kountouris, Nakic, and Sauer [59], specific timing was used to collect data. According to Latinopoulos, Mallios, and Latinopoulos [60], survey data may be considered as a form of public investment at an early stage of planning, which is likely to improve the public acceptance of the proposed projects. The suggestions made based on the research results should be of interest to researchers and policy makers looking for a way to introduce parks to be created from old landfills. It should be highlighted that this study effort is not a common practice in this part of Europe, where people have a certain measure of distrust and fear of certain types of government policies.

Based on public park visitation trends and tourism trends in the city of Zagreb [61], as well as the data obtained by the contingent valuation method (CVM) survey [56], the hypothetical recreational park atop the current landfill is expected to be most visited by local citizens, domestic tourists, and foreign tourists, respectively. As much as 96% of the respondents are willing to visit the park in the future. The respondents' gender ratio is 33:67 between males and females. The dominant age group is 30–49 years (42.8%), whereas the other two age groups were distributed evenly. 42% of respondents are single and 39% of respondents are married. According to these study results, the majority of respondents hold a master's or higher university degree (62.4%). Only 8.9% hold a bachelor's degree as the highest level of education, and 28.9% of respondents graduated from high school. More than half of the respondents (54.2%) earn HRK5,000–10,000 every month, which corresponds to the average of a net monthly salary in Croatia for September 2019—HRK6,418 [62]. 38.7% of respondents earn less than HRK5,000, and 7% of respondents earn more than HRK10,000.

In regard to travel habits, 62% of respondents visit public parks monthly or during holidays, whereas 22% of them go more frequently, on a weekly basis.

Their main means of transportation is personal vehicle (48%), followed by public transportation (18.5%), bicycle (16.2%), and walking (14%). In the case of purpose of visiting a park, 46.9% of respondents consider fresh air as the main purpose of visit, and 13.7% say it is sightseeing, followed by 12.2% of respondents that report natural resources (12.2%) as the main purpose of their visit. The respondents spend HRK11.89 on average when visiting a park.

Two of the questions in the CVM survey were presented with pictures in color for better understanding, as they were related to perceived experience with regard to the status of the current landfill (**Figure 2**, **Table 2**). According to results, 49.4% are moderately aware of the status of the area around the landfill, 13.3% have never seen it, and 37.3% are well aware of it. When it comes to the respondents' perceived experience with respect to the landfill-park conversion, the majority cannot wait to enjoy the new park (54.2%), 38.7% are more focused on the landfill being closed, and only 7% welcome the project as they assume it will help in reducing the crowd in other parks. In regard to desired conversion of Jakuševec landfill, 131 respondents (48.3%) said that they would like to see a recreational park built, 78 respondents (28.8%) prefer a theme park, and 50 respondents (18.5%) would like to see a forest, whereas real estate land for commercial development and other was answered by 4 people (1.5%) for each of the categories.

The foregoing findings provide the following conclusions and suggestions for this potential land use transformation from landfill to a city recreational park in the city of Zagreb. First, converting the waste landfill site to a recreational park perhaps is one of the best choices. This is aligned with the Spatial Plan of the City of Zagreb and the concept Zagreb on Sava [63], which aims at redesigning the Sava river

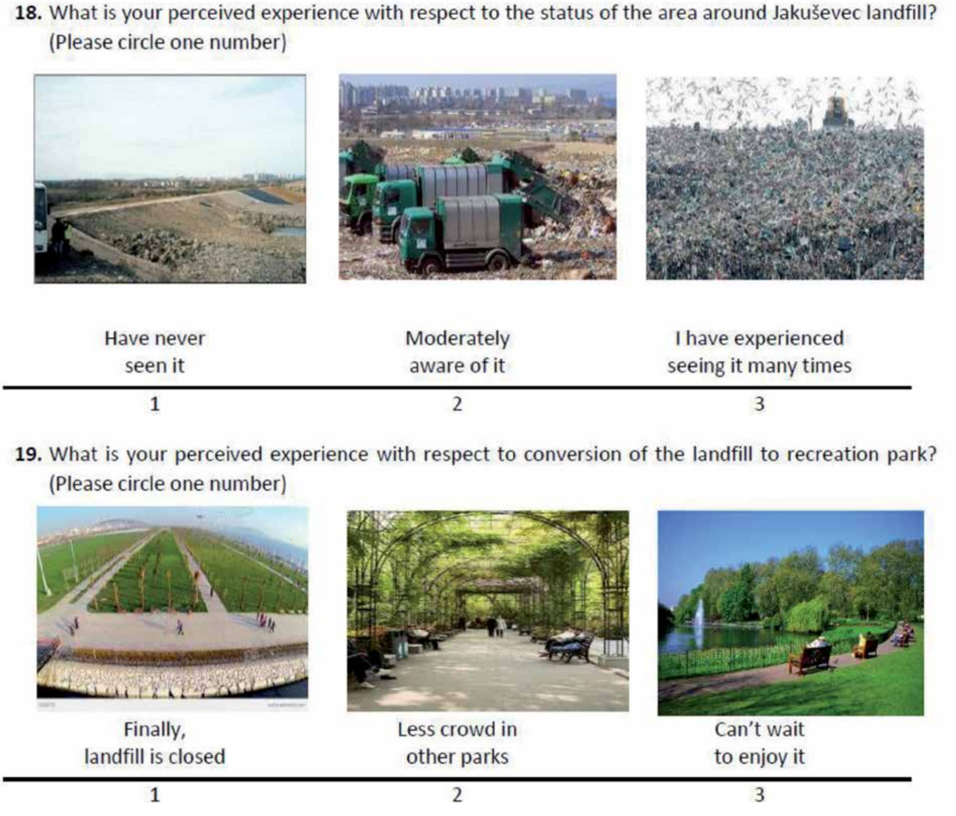

Figure 2.
Visitor's perceived experience.

Demographic variable	Frequency	%
Perceived experience with regard to the status of the area around Jakuševec		
"Have never seen it"	36	13.3
"Moderately aware of it"	134	49.4
"I have seen it many times"	101	37.3
Perceived experience with regard to conversion of Jakuševec landfill to a recreational park		
"Finally the landfill is closed"	105	38.7
"Less crowd in other parks"	19	7
"Cannot wait to enjoy the new park"	147	54.2

Table 2.
Perceived experience of visitors with regard to the status of Jakuševec landfill.

banks to be stretched from Slovenia to Croatia (Sisak) in order to best serve citizens' recreational and leisure activities. Thus, it is foreseeable that the strategy of ceasing the current landfill operations and converting it into a recreational park in Zagreb seems to fit the city's overall landscape design. Second, besides trees, flowers, and other types of fauna and flora, it may be beneficial to add more products and services to the park including to encourage park (re)visitations among different age groups. Third, the performance of parks can be improved by using a combination of newer physical surroundings together with promotional activities. Fourth, physical surroundings or attributes that contribute to consumers' perception and consumption experience possess (i) utilitarian value, namely, goal-oriented, functional, and instrumental, and (ii) hedonic value, related to the immediate personal satisfaction gained from emotional benefits provided by consumption experience. Fifth, newness and novelty can be influenced by different factors such as the time interval between two visits, the duration of the trip, the periodicity of service usage, and individual perceptual abilities. Finally, the study results contribute both theoretical and empirical literature credible solutions for efficient landfill conversions, nonmarket resource management, waste management, environmental protection, and novelties among park facilities and payment vehicles [64]. The model presented here can be used as an example for any projects that require a cost–benefit analysis of nonmarket valuation to alleviate policy development for the management of public resources and financial sustainability at both local and national levels.

5. Policy suggestions

It is crucial to notice that only participation and awareness from the beginning of a policy planning can end up in public acceptance [65]. After developing a policy, an effective implementation has to take place. In order to reach its goal, a policy-to-implementation process should include the following steps: constructing operational rules and guidelines; organizing and allocating human and financial resources effectively; applying monitoring system for all-level-policy and program decisions; setting up a multi-directional feedback process for beneficiaries, implementers, and policy makers; establishing follow-up mechanisms to ensure compliance with policy; and introducing a policy implementation evaluation system. In terms of environmental protection, new (or altering existing) environmental regulations and control systems that will have an effect on the activities that are subject to it should be developed. Therefore, it is critical to develop an overall strategy for compliance and enforcement.

Several suggestions in terms of landfill-park conversions for decision makers were derived:

- Landfills should be inexpensive to buy, free of charge, or supported by loans, subsidies, or grants, as their conversion and maintenance costs are high.
- Different financial models should be created for different conversions.
- Conversion and maintenance costs can be shared by the former landfill owner and the new owner.
- The closure and the new use of a site have to be well researched and planned and supported by standard regulations issued by environmental protection agencies to adequately address gas production and ground settlement issues.
- The municipality or other legal entities should assist these kinds of projects, financially or in any other way that will make them a reality.

After developing a policy, an effective implementation has to take place in order to successfully achieve intended results [66]. Policies require various inputs to reach their goals [66]: clear implementation plans, strong leadership, cross-sectoral stakeholder involvement, adequate resources, and effective monitoring systems. In ideal circumstances, the following sequence would exist:

1. Policies would be translated into constructive operational rules and guidelines.
2. Resources, namely, human and financial, would be allocated and organized efficiently.
3. Monitoring systems would be applied for all-level-policy and program decisions.
4. A multi-directional feedback process would be established for beneficiaries, implementers, and policy makers.
5. Follow-up mechanisms would be set up to ensure compliance with policy guidelines (e.g., national monitoring board or sanctions for noncompliance).
6. Policy implementation evaluation system should be introduced.

Policy issues may appear throughout the entire policy-to-action continuum, which is the reason why it is essential to understand the nature of policy implementation [67]. In that aspect, a key capability for policy makers is the ability to address the barriers to policy implementation.

6. Conclusions

Sites such as landfills, decommissioned animal feedlots, and manufacturing plants constitute a challenging problem faced by city management, especially for regions and locations which have limited land areas to be utilized for such a purpose. The challenges come from the constraints of the land space and from finding proper land use alternatives after it becomes decommissioned. To ensure an efficient utilization of land recovery find out the best land use alternatives, the decision makers should make sure to assess the economic value to be potentially accrued by the recovered resources or by the potential consumers who are directly affected by the land recovery strategies. The Jakuševec landfill-park conversion suggested in this chapter represents a great opportunity to become a relevant example to similar scenarios in the future.

Urban parks are fundamental to social and psychological well-being of city residents and a key component for city sustainability. While parks contribute to the beautification of the city and have positive effects on environmental quality, spending time in parks has restorative effect on people's mood and stress release. Based on empirical results and relevant literature in key components of surroundings and how customers perceive it [23, 51, 52, 68], several conclusions are drawn:

- Physical surroundings that are most commonly recognized to have an impact on consumers' perception of quality and behavioral intentions include special layout and placement, ambient conditions, facility esthetics, cleanliness, and electronic equipment and display.

- There is a significant impact of novel physical surroundings on revisitation behaviors, and other studies report that relationship can be mediated by hedonic shopping values and utilitarian shopping values.

- Park performance, in terms of consistent visitations, can be improved by implementing a market positioning strategy, by investing in a combination of promotional activities and newer physical surroundings.

- In the absence of close alternatives, visitors will search for any setting associated with satisfying their needs for relaxation.

- To retain positioning, parks can implement an effective strategy of refreshing the visitor experience on a regular basis.

- Newness and novelty can be influenced by different factors such as the time interval between two visits, the duration of the trip, the periodicity of service usage, and individual perceptual abilities.

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Chapter 6

Folk-Based Outdoor Games as Means to Improve the Physical Activity and Emotional Well-Being of Pre-School Children

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Abstract

In this chapter, we will discuss outdoor games and explain the value they can have for 2–7-year-old children. An outdoor game means performing a wide range of movements, such as running, jumping, throwing a ball, etc. while following a certain set of predefined rules. It often includes some kind of spoken verse, nursery rhymes, and reference to folklore. These components define the game's story and help the children become more engaged within the game. In Russia, kindergartens conduct specially organised classes with children, to help them develop communicative skills, memory, and creativity. These classes (games) can have a positive effect on the child in a whole range of areas: physical, intellectual, emotional and communicative. They provide a benefit to the children's health, improve their cardiovascular/respiratory systems, strengthen the muscles and bones. In our research, we asked the teachers to observe the children's progress when taking part in outdoor games. Changes were evaluated on the basis of the so-called "play activity organisation". Play activity not only promotes the child's comprehensive development but is also a good indicator of the child's developmental age. In this chapter, we also provide examples of actual play exercises that involve phrases from folklore.

Keywords: pre-school children, outdoor games, folklore, physical activity, emotional well-being

1. Introduction

Pre-school age children (2–6 years old) enjoy play. They play on their own, with their parents or older siblings and with their teachers.

This is due to the fact that for pre-school age children, play is the main type of activity. Through play, the child discovers the world, develops vital faculties and skills, including motor skills, and learns the rules and norms of social behaviour.

Today in Russia, play is a significant part of daily routine in kindergartens, taking place both indoors and outside. The games children learn with their teacher can then also be played at home and when going on trips.

Teachers employ a vast number of different types of games when working with pre-school children [1, 2].

The special significance of folk-based outdoor games is that they are easily accessible to kids starting from the youngest age. Outdoor games can be very diverse. They reflect national traditions, help develop adaptation and decision-making skills, improve motor activity and enhance communicative and creative abilities. From a methodological viewpoint, an outdoor game should be considered as a multifaceted, comprehensive pedagogical means for balanced education. It is all encompassing because it helps to develop motor skills and refine essential physical, mental and emotional-volitional qualities [3–5].

When motion activities contain a competitive element, folk-based games can also be used as preparation for participating in sports games.

Proper selection and guidance in games are crucial for assisting pre-school children in growing a sense of collectivism, assertiveness, initiative, perseverance in achieving their goals, confidence and good command over their emotions.

Due to the range of the educational effect achieved by folk-based outdoor games, there are certain requirements toward the methods of their organisation. The most common requirements are the following: the games should reflect people's lifestyle, psychology, traditions and culture; the difficulty of the games' story and content should be appropriate for the participants' age, intelligence, skill and physical ability level. The selection of games and play tasks needs to align with the objectives of pre-school children's education [2, 6, 7].

In the following section of this chapter, we will look at what exactly outdoor games are. We refer to the opinion of the famous nineteenth century Russian educator and physiologist, Peter Lesgaft, regarding the value of outdoor games which is needed for children's comprehensive development. We will also define the value of outdoor games for kids in today's world.

Further, in Section 3, we describe the organisation of play activities with children in kindergartens and the amount of time dedicated to outdoor games during a day and give examples of outdoor games with rhymes that help children properly perform the movements involved.

That section will also provide the results of our research on how outdoor games can affect the child's physical and psychological development. We describe the sets of games that teachers and parents can use, e.g. during everyday walks or family trips.

2. What are outdoor games, and why teach them to children?

An outdoor game is a specially organised motion-based activity that allows the child to learn essential life skills and abilities, as well as to interact with other participants. These games can become much more exciting for children if they include phrases and rhymes taken from folklore. The games are made up of tasks that should be executed by following certain preset rules, and by combining motion with speech (rhymes) in these tasks, children can better learn the movements as well as interact with other kids and adults who are participating in play. The famous Russian doctor, physiologist and teacher Peter Lesgaft emphasised the significant role of outdoor play in the child's physical and psychological development [1]. He viewed play as an aid in the kids' comprehensive personality growth that can teach the child honesty, integrity, discipline, self-control and a sense of camaraderie. Lesgaft recommended using games so that children could learn to control their own behaviour. Through motion-based play, children can strengthen their musculoskeletal, respiratory and cardiovascular systems and develop movement coordination, agility and force.

Today's teachers, psychologists and parents take interest in how outdoor games can have a positive effect on the children's development. This becomes especially relevant in an era when kids do not get as much movement during the day, spending more time in front of television or electronic devices. Therefore, it is essential that outdoor games, with their high amount of motion activity, be included in the child's daily routine.

Researchers define the so-called "play activity organisation" as one of the indicators of the children's developmental age, specifically their intellectual, emotional and physical development level. To evaluate these, we have conducted a research based in Russia that involved 300 children aged 2–7 years old. These children attended kindergartens, where teachers organised dedicated classes involving outdoor play with elements of folklore. The researchers analysed the kids' developmental age indicators and composed specialised sets of outdoor games that can be used both in kindergartens and at home, during regular walks and family trips [4, 5, 8].

3. Psychological and physiological effects of folklore-based outdoor games for 2–6-year-old children

Outdoor games can have a significant role in health, discipline and education and can be successfully used when working with children in kindergartens. They are proven to facilitate children's physical development and have a positive effect on the nervous system and overall health. They can also be a very engaging sports activity that puts out a lot of physical stress on the child's body, which should certainly be taken into account when organising classes and games with pre-school age children [1, 4, 6, 9].

Nearly each game involves running, jumping, throwing, balance exercise, et cetera. Games help develop the child's primary physical qualities, such as strength, dexterity and endurance while enhancing numerous motor abilities and skills that the child will require later in life.

Participating in play contributes to the child's physical, intellectual, ethical and artistic development. Under proper guidance, a wide variety of movements and actions during play can positively affect cardiovascular and respiratory systems, help strengthen the nervous system and the motor apparatus, boost general metabolism as well as all human organs and systems, increase the appetite and improve sleep. Through outdoor games, we can ensure the child's comprehensive development [5, 6, 8, 9].

During play, pre-school children develop and master various primary movement skills (running, jumping, throwing, climbing, etc.) In games, situation changes quickly, and that teaches the child to use the learned movements in accordance with what is happening at any given moment. All of this has a positive effect on improving motor skills and abilities. Outdoor games also have a physiological effect on the child's body. Children demonstrate better movement coordination, agility and muscle force. These factors are most notably increased at 5–7-year-old age.

Outdoor play can also be of great importance for a pre-school child's personality growth. In games, children can use their own experience, while deepening and solidifying their view of the events being imitated in play, and their outlook on life. Much like an adult, the child learns of the world through experience. Game participants acquire new sensations, concepts and ideas. Games expand their range of ideas; enhance attentiveness, ingenuity and the ability to analyse; compare and generalise what they have seen; and help children learn how to come to one's own conclusions based on observing the environment. In outdoor play, the child develops the aptitude to correctly evaluate spatial and time relations, as well as quickly and appropriately react to the rapidly changing situation within the game. Games conducted outdoors both in summer and winter can be of tremendous value for education.

Games can be organised outdoors at any season of the year. The duration of play with children aged 3 to 6 depends on the game's intensity, the complexity of movement involved and the children's physical development level and health condition. It can usually average from 10 to 20 minutes.

Table 1 presents the formats of work and the amount of time dedicated to play for pre-school age children during a routine day in kindergarten.

The results presented in **Table 1** show that the time specifically allocated for playing activities is sufficient to achieve the goals of discipline and education in kindergartens. Two- to three-year-old children have around 5 hours of playtime per week, i.e. about 1 hour per day. For children of 6–7 years old, special game classes and tasks amount to about 105 minutes a day, i.e. 1 hour 45 minutes. Each of the work formats described employs some elements of folklore.

Not all work formats are used daily. Dynamic games and outdoor physical exercise (morning and afternoon), as well as games, round dances and game exercise during the day, are compulsory and take place each day. Other types of work are scheduled one or two times a week.

Table 2 provides sample exercises that use verses, counting rhymes and nursery rhymes, to help children in performing the tasks. This verse-type accompaniment is based in folklore.

The above exercises can be used both in musical rhythmic classes and in gaming tasks.

Table 3 provides examples of folk-based outdoor games that can help develop various qualities and skills in pre-school age children.

The results of the experimental work have shown that the use of specifically selected games and exercises, especially folklore-based, can help develop physical and personal skills in kindergarten children, as well as correct any psychological and physiological development issues.

A well-organised play activity prevents children from "wasting" their energy, does not require additional motivation, is easily understood and implemented by the teachers, does not require creating special conditions and helps to "lessen the load on the left hemisphere".

Formats of work	2–3 y.o.	3–4 y.o.	4–5 y.o.	5–6 y.o.	6–7 y.o.
Dynamic games and outdoor physical exercise (morning, afternoon)	125	150	175	200	200
Games, round dances, game exercise during the day	60	75	100	125	150
Music and rhythm classes	45	45	60	90	105
Game therapy	15	15	20	30	30
Supervised game room visits	20	25	30	40	40
Total	265	310	385	485	525

Table 1.
Time per week dedicated to play activities for kindergarten children (minutes).

#	Exercise	Text (translated from Russian)
1.	We are Growing!	*Higher, higher shall we grow;* *Stretch the hands to reach the top!* (Children stand on their toes, stretching the hands up.) *One and two, higher we go,* *three and four – now hands we drop!* (Going back down, feet firmly on the floor, hands drop.)
2.	Butterflies	*Exercise will go like that:* *put your hands behind your head;* (Children bend their arms and lock their hands behind their head.) *Like butterflies we fly and fly, wings together, spread them high.* *One, two, two, one, all the class shall move as one!* (Moving the bent arms together and apart.)
3.	Catch the Fly	*Time to put our hands up high;* *we shall try to catch the fly!* *After that, we bring them down,* *to the start and back around!* (Children rotate their body left and right, bring the arms up, clap their hands.)
4.	Airplane	*Spread our hands out left and right,* *plane is coming into flight,* *Swinging wings from side to side,* *One and then another time!* (Feet shoulder width apart, arms spread out, tilting the body left and right.)
5.	Maple Tree	*Quietly shaken by the wind,* *left and right the maple trees* *Bending one and two and three,* *making noises with the leaves.* (Feet shoulder width apart, hands behind the head, children tilt their body left and right).
6.	Weathercock	*Today we build a weathercock.* *Let us all turn around the clock!* *Wind is blowing right and left,* *wings are turning quick and deft.* (Hands behind the head, children turn their torso right and left.)
7.	Lumberjack	*Lumberjacks we are becoming,* *axes high – and here we coming,* *Swinging hands, our merry gang,* *log is splitting with a bang!* (Feet shoulder width apart, arms above, fingers locked together. Children bend forward, breathing out deeply, altogether saying 'Bang!')
8.	Roly-Poly	*Roly-poly! Squatting lowly!* *Naughty little child you are,* *cannot quite handle you so far!* (Children sit down; put their hands on their knees, nodding their head down.)
9.	Dwarfs and Giants	*Wonders right before our eyes:* *children shrinking down in size!* *Then they stand up, and from dwarfs* *into giants they shall morph!* (Children sit down, put their hands on their knees and lower their head. Then they stand up on their toes, stretch their hands up and bend their backs in.)
10.	The Ball	*Jumping, jumping, little ball,* *off and far away it goes!* *Hop and hop, and many more,* *we are landing on our toes!* (Children jumping up and down on two legs.)
11.	To the Parade!	*Strong and bold our great brigade,* *coming out to the parade!* *Raise your foot and keep eyes straight,* *little soldiers marching great!* (Children march in place raising their knees up high.)

#	Exercise	Text (translated from Russian)
12.	Little Sun	*Children, sun is above ground!* *Can you breathe in deep? Let us see.* *Then we bring our hands back down,* *breathing out and feeling free.* *One, two, breathing in;* *three, four, breathing out.* (Children rise on their toes, hands up, then bend and lower their hands down.)

Table 2.
Example of folklore-based exercises.

#	Name of the game	Qualities
1.	"Close Acquaintances", "Remember the Movement", "Forbidden Movement"	Attentiveness, discipline, quick reaction
2.	"Find your Spot", "Guess who's shouting and where"	Spatial orientation, sense of collectivism
3.	"Spindle", "Return to your Place", "Riding the Ball", "Rotate Together"	Movement coordination, flexibility, attentiveness
4.	"Butterflies and Dragonflies", "White Bears", "Fight for the Ball"	Dexterity, attentiveness, willpower

Table 3.
Examples of outdoor games for pre-school children.

At the start of the experiment, we set a task of picking out the diagnostic materials for analysing the play activities of pre-school children. The methods of Kalinina [8] were chosen as the most accessible for the teaching staff to conduct systematic work at kindergartens. The pre-school children's play activity was analysed by the following criteria: primary play content, role-play, actions during play, using props and mock-up tools, role-based speech and following the rules. Each of the criteria was evaluated using a five-point scale, from the lowest (1) to the highest (5) level of play activity organisation.

The analysis of the kids' play activity is performed using the pedagogical observation method. The observation results are placed in a clearly laid out summary table. This table notes the last name of each child, the child's age and their play skills according to each criterion. The work that followed was concerned with designing game sets (see **Tables 2** and **3**) that included games and play tasks aimed at developing self-regulating behaviour, reducing psychological and emotional stress, developing communicative and emotional-volitional skills, movement coordination, nervous system process training, teambuilding in children's groups and promoting interaction within the teacher-kid pair.

A feature of these game sets is that they include games that can be used in various types of classes: physical education, music, game therapy, outdoor walks, group room classes and independent play, as well as at home and during family trips.

The class schedule includes special organisational moments when children learn the games, after which these games can be used by teachers in different types of classes.

Over the course of 3 years when these game sets were routinely used in kindergartens, we obtained positive results regarding the organisation of play activity for pre-school children. The results demonstrate that there were changes in play activity among the same children throughout the observation period. The kids' approximate age was 3–6 years. Percentages indicate the number of children in a group who performed the game tasks at the level appropriate for their developmental age.

We saw that for the "primary play content" criterion, where the child has to use tools or interact with other players, the group indicators rose from 15 to 71%.

The "role-play" criterion refers to the child playing a certain role defined by the rules of the game. These indicators improved from 51 to 97%. The diversity, logical consistency and mastery of game actions were reflected by the "actions during play" criterion. The pre-school children group showed an increase from 22 to 98% [4, 5].

The game sets contain folklore-based games that include certain speech segments necessary to conduct the game. Some games involved reciting rhymes related to role-play. Such games are especially important for the development of speech in children. In terms of the "role-based speech" criterion, the group indicators have improved from 16 to 85% [4, 5].

Many games and play tasks involve using play tools, certain pieces of attire or sports equipment. The ability to use these tools appropriately, in accordance with the rules of the game, is another characteristic of pre-school children's play activity organisation. The criterion "using props and mock-up tools" increased from 23 to 90% in the group.

Compliance with the rules of the game among children improved from 63% at the start of the observation to 98% by the end [4, 5].

4. Conclusion

The use of specially designed game sets, including various types of games and play tasks based in folklore, used properly in pre-school age children's daily routine, can help children develop a high level of playing abilities and skills. Specially organised play classes in kindergartens improve the child's emotional-volition sphere and promote intellectual growth, social contacts and mutual understanding among children as well as between kids and adults.

The following are some of the advantages:

- Game sets are easily accessible to teachers in children's educational institutions and can be used for working with pre-school kids.

- Play activity can correct issues in pre-school children's psychological, physiological and motor development. This process is especially effective when the games are included in various activities and compulsory or extracurricular classes conducted in kindergartens. Our observation of play activities among 2- to 7-year-old kindergarten children has indicated that properly selected games and play tasks can help ensure the child's comprehensive development.

- The inclusion of outdoor games with elements of folklore can enhance the child's motion abilities and have a positive effect on cardiovascular and respiratory systems.

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Outdoor recreation refers to recreation/activity executed outdoors, most commonly in natural settings. At least in many high-income countries, outdoor recreation is by many considered as an attractive activity during spare time or holidays. People actively seek out activities such as walking in the mountains, climbing, hunting, horseback riding, skiing, etc., which are very often difficult to accommodate in ordinary working days. Some people find outdoor recreation attractive to the extent that they take several months or a year off from work in order to spend time in nature. Outdoor recreation stimulates a healthy lifestyle and increases public health, and it is important to develop outdoor activity habits from early childhood, a habit that should last for an entire lifetime. This book will take you through the definitions of outdoor recreation and different types of recreation. Furthermore, the book will also give you a snapshot of the physiological and psychological effects of outdoor recreation and why outdoor recreation is important for development in children and adolescents, and for adults and the older population, in addition to descriptions of some of the major and maybe the most used outdoor activities.

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