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Physical Activity: A Prerequisite for Optimum Immunity of the Elderly

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Abstract
Physical activity has a major impact on health. Some effects are well established; as a major component of energy expenditure, physical activity has a great influence on energy balance, body composition and the immune system. Previous studies, show that over the last century, people have become less active, adopting more sedentary habits. This scenario has increased the incidence of chronic diseases such as cardiovascular diseases, type 2 diabetes and metabolic syndrome which may be directly or indirectly traced to the immune system. The practice of physical activities can influence healthiness by altering the metabolic state and also the immune system. This work is about how physical activities affect optimum immunity in the elderly. The concept of physical activity was discussed where the different activities were classified as; aerobic, strength training, balance and flexibility activities. Immune system was discussed and was stated as the system that defends the body against disease causing agents. The different ways of boosting the immune system was analyzed and they included; eating healthy, staying hydrated, being physically active, getting adequate rest among others. Physical activities that help boost immunity in the elderly was explored, and some of them includes; aerobic activities, muscle-strengthening activities among others. It was discovered that physical activity boosts the production and optimum performance of bodily substances like white blood cells. The study also discovered that excessive prolonged physical activity could lower the immune system. In conclusion, it was noted that moderate bouts of physical activity tend to have an immune system boost that lasts for short periods of time after the activity has been completed. Based on the conclusions of the paper, it was recommended among other things that the elderly should engage in a total of at least 30 minutes of moderate-intensity physical activity a day, on five or more days in a week.
Key words: Physical Activity, Immune System, Immunity, Ageing, Elderly

Introduction

Physical activities are very important to life. They involve movements one engages in during daily tasks. The World Health Organization WHO (2010) defined physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure. Physical activity includes exercise as well as other activities which involve bodily movement and are done as part of playing, working, active transportation, house chores and recreational activities. Physical activity encompasses all activities, at any intensity, performed during the 24-hour day (Pedišić 2014). It includes exercises and incidental activity integrated into our daily activity. This integrated activity may not be planned, structured, repetitive or purposeful for the improvement of fitness, and may include activities such as walking to the local shop, cleaning, working and active transport. (WHO 2010) stated that worldwide, 23 percent of adults and 81 percent of adolescents (aged 11–17 years) do not meet the global recommendations for physical activity. The prevalence of inactivity varies considerably within and between countries – it is as high as 80 percent in some adult populations – and inactivity increases with economic development, owing to the influence of changing patterns of transportation, use of technology, urbanization and cultural values.

Exercise and physical activity are frequently used interchangeably and generally refer to physical activity performed during leisure time with the primary purpose of improving or maintaining physical fitness, physical performance, or health. Physical activity is not exactly the same concept as exercise. Exercise is defined as a subcategory of physical activity that is planned, structured, repetitive, and purposeful in the sense that the improvement or maintenance of one or more components of physical fitness is the objective (WHO 2010). Conversely, physical activity includes exercise but may also be unplanned, unstructured, random and non-purposeful carried out for a multitude of reasons. Physical activity can be defined more physiologically as any bodily movement provided by skeletal muscles that results in a substantial increase over the resting energy expenditure (Reznik, 2017). Under this broad rubric we consider active physical leisure, exercise, sport,

occupational work and chores, together with other factors modifying the total daily energy expenditure which also impacts the body's immune system.

The immune system protects against destructive forces either from outside the body (e.g., bacteria, viruses, and parasites) or from within (e.g., malignant and autoreactive cells). It comprises two functional divisions that work together in a coordinated manner. The innate immune system consists of cellular components, soluble factors, physical barriers, and the reticuloendothelial system (Goldsby, Kindt, Osborne, 2001). It provides a first line of defense against foreign pathogens while an acquired immune response is activated. The acquired immune system produces a specific reaction and immunologic memory to each pathogen and comprises cellular components and soluble factors (Goldsby, et al. 2001). Physical activity is a prerequisite for an efficient immune system in the elderly. Prerequisite means something that is required as a prior condition for a particular outcome. Therefore, from the definition, physical activity is required as one of the conditions for an optimum immunity in the elderly. Optimum immune system is particularly important in the ageing process of the elderly people and one of the ways to achieve this optimized immune system is through active participation in physical activities.

Concept of Physical Activity

Exercise, sport, play, games, dance - these and many other terms have been used to describe the wide variety of pursuits considered to be physical activity. Physical activity is a universal term defined as bodily movement that is produced by the contraction of skeletal muscles and that substantially increases the amount of energy one expends (Caspersen, Pereira & Curran, 2000). The term is typically used for calisthenics, resistance exercises, stretching exercises designed for flexibility, and aerobic exercises specifically designed to improve cardiovascular fitness. Sport, play, games, dance, and recreational activities are all different forms of physical activity, some are more organized than others. Physical activities can be of different types, they include; aerobic, strength training, balance and flexibility activities.

Endurance, or aerobic activities increase one's breathing and heart rate. They keep the heart, lungs, and circulatory system healthy and improves overall fitness. Building endurance makes it easier for an individual to carry out many of his or her everyday activities. Endurance exercises include: brisk walking or jogging, yard work (mowing, raking, digging), dancing.

Strength exercises make the muscles stronger. They may help one especially the elderly stay independent and carry out everyday activities, such as climbing stairs and carrying groceries. These exercises also are called strength training or resistance training. Strength exercises include: lifting weights, using a resistance band, using your own body weight.

Balance exercises help prevent falls, a common problem in older adults. Many lower-body strength exercises will also improve your balance. Balance exercises include: standing on one foot, heel-to-toe walk, tai chi.

Flexibility exercises stretches the muscles and can help make the body stay limber. Being flexible gives you more freedom of movement for other exercises as well as for your everyday activities, including driving and getting dressed. Flexibility exercises include: shoulder and upper arm stretch, calf stretch.

Physical activity can be further categorized in terms of the frequency, duration and intensity of the activity. Frequency and duration refer to how often and how long an activity is performed. Intensity refers to how hard a person is working or the rate of energy expenditure that an activity demand. Physical activity has a major impact on health. Some effects are well established; as a major component of energy expenditure, physical activity has a great influence on energy balance and body composition. It is also recognized that physical activity is a major independent modifiable risk factor which has a protective effect on cardiovascular disease (CVD), stroke, type 2 diabetes, colon and breast cancers, and is also associated with other important health outcomes such as mental health, injuries and falls. According to the University of Birmingham Department of Kinesiology, (2018), physical activity reduces the risk for cardiovascular disease, type II diabetes, certain cancers, and other chronic health conditions. The report also opined that physical activity help with weight control, strengthens bones and muscles, improves mental health, mood, and energy level and as well improves the immune system. Conversely, physical inactivity (lack of physical activity) has been identified as the fourth leading risk factor for global mortality (6% of deaths globally). Moreover, physical inactivity is estimated to be the main cause for approximately 21–25 percent of breast and colon cancers, 27 percent of diabetes and approximately 30 percent of ischemic heart disease burden (WHO 2010). These consequences of physical inactivity also affect the elderly persons as well as their immune system.

Concept of Immune System

Our immune system is essential for our survival. Without an immune system, our bodies would be open to attack from bacteria, viruses, parasites, and more. The immune system (from the Latin word immunis, meaning: "free" or "untouched") protects the body like a guardian from harmful influences from the environment and is essential for survival. It is made up of different organs, cells and proteins aside from the nervous system, it is the most complex system that the human body has (Pollock, 2018). The immune system is a complex system in which a multitude of different cells throughout the organism interact with each other, either directly or through a variety of soluble mediators, to achieve a thorough defense of the organism against foreign attacks while maintaining control of correct cell proliferation within the body (Camil & Iris, 2013). Without an immune system, a human being would be just as exposed to the harmful influences of pathogens or other substances from the outside environment as to changes harmful to health happening inside of the body. The main tasks of the body's immune system are:

- Neutralizing pathogens like bacteria, viruses, parasites or fungi that have entered the body, and removing them from the body
- Recognizing and neutralizing harmful substances from the environment
- Fighting against the body's own cells that have changed due to an illness, for example cancerous cells.

Everyone's immune system is different. Some people never seem to get infections, while others seem to be sick all the time. According to Delves (2017) there are things that can be done to help strengthen the immune system, they include:

- Eating foods that are rich in antioxidants like vitamins C and E, carotenoids (building blocks of vitamin A), and omega-3 fatty acids. Choose deeply colored produce like peppers, broccoli, carrots, leafy green veggies, tomatoes, and citrus fruits; nuts, fatty fish like tuna, salmon or sardines; and whole grains.
- Staying hydrated by drinking sufficient amount of water daily. Not only does drinking sufficient fluid help flush out toxins from the body, it helps keep the mucus membranes in the nose and respiratory system moist and more resistant to germs.
- Exercising regularly**.** Regular moderate exercise, like brisk walking, can boost the immune system's antibody and T cell responses.
- Getting enough rest**.** Chronic lack of sleep affects the whole body, including the immune system. Children need 9-11 hours, adolescents need about 9 hours, and adults need 7-9 hours of sleep a night. Full schedules make it easy to be sleep deprived, so establish a healthy bedtime for everyone in the family.
- Controlling stress. While some situations are a real crisis, it's the day-to-day events that are often the most overwhelming and stressful. Everyone has daily stress. The key is how you deal with it. To control stress, one should**;** set limits and priorities, be willing to delegate tasks when others offer their help, create a support system and as well as laugh.
- Washing the hands after coughing, sneezing or blowing your nose, using the bathroom, touching pets, playing outdoors, when caring for someone who's sick, and before preparing or eating food. Use plenty of soap and water, and remember to lather up for a full 20 seconds. An alcohol-based hand sanitizer can also be used.
- Keeping immunizations up-to-date**.** Vaccines help the immune system identify a disease's presence - and destroy it before it has a chance to multiply inside your body and cause illness. Check with your health care provider about an annual flu shot, and whether anyone (children, adult and the elderly) in your family is due for a "booster" shot for other vaccinations. Ask about the pneumonia vaccine.

The Elderly

One is said to be elderly if he or she is advanced in age. Most developed world countries have accepted the chronological age of 65 years as a definition of elderly or older person, but like many westernized concepts, this does not adapt well to the situation in Africa. While this definition is somewhat arbitrary, it is many times associated with the age at which one can begin to receive pension benefits. At the moment, there is no United Nations standard numerical criterion, but the UN agreed cutoff is 60+ years to refer to the older population (WHO, 2010). Although there are commonly used definitions of old age, there is no general agreement on the age at which a person becomes old. The common use of a calendar age to mark the threshold of old age assumes equivalence with biological age, yet at the same time, it is generally accepted that these two are not necessarily synonymous. The ageing process is of course a biological reality which has its own dynamic, largely beyond human control. However, it is also subject to the constructions by which each society makes sense of old age. In the developed world, chronological time plays a paramount role. The age of 60 or 65, roughly equivalent to retirement ages in

most developed countries, is said to be the beginning of old age. For the study, an elderly is someone who is advanced in age, and are above 60 years of age.

Aging is a multifactorial irreversible process associated with significant decline in muscle mass and neuromuscular functions (Hickey, 2010). Studies have shown that one of the most efficient methods to counteract age-related changes in muscle mass and function is physical exercise (Hickey, 2010). Significant health benefits are seen in adults aged 65 years and older who participate in regular physical activity. The elderly can choose any exercise they like and feel comfortable doing. It could be as simple as going up and down the stairs, jumping rope, biking, or swimming. The key is to listen to your body so as to avoid injury and the risk of jeopardizing the body's immune system.

The Role of Physical Activity in The Improvement of Body's Immunity in the elderly

Physical activity is paramount in maintaining an optimum immune system. Exercise can have both a positive and negative effect on the functioning of the immune system and can influence a person's vulnerability to infection (Nieman, Henson, Austin & Sha, 2011). Researchers have found a link between moderate regular exercise and reduced frequency of upper respiratory infections (URTI) compared with an inactive state and also with excessive amounts of exercise and an increased risk of URTIs. A one-year study of over 500 adults found that participating in 1-2 hours of moderate exercise per day was associated with a one third reduction in the risk of getting a URTI compared with individuals that had an inactive lifestyle (Nieman et al. 2011).

Other studies have shown that people who exercise two or more days a week have half as many days off school or work due to colds or flu as those who don't exercise (Hickey, 2010). However, more is not always better in terms of exercise volume as a study by Gleeson, Bishop and Walsh (2013) reported a 2 to 6-fold increase in risk in developing an URTI in the weeks following marathon (42.2 km) and ultra-marathon (90 km) races. This according to the authors is due in part, to increased levels of stress hormones like adrenaline and cortisol that suppresses white blood cell functions. After strenuous exercise, athletes enter a brief period of time in which they experience weakened immune resistance and are more susceptible to viral and bacterial infections, in particular URTIs. Post-exercise immune function depression is most pronounced when the exercise is continuous, prolonged (>90 minutes), of moderate to high intensity (55-75% of aerobic capacity), and performed without food intake (Gleeson et al. 2013). Another problem for athletes is that their exposure to pathogenic (disease causing) microorganisms in the environment may be higher than normal due to increased rate and depth of breathing during exercise (increasing exposure of the lungs to airborne pathogens), exposure to large crowds and frequent foreign travel. Some of the reported sore throats may not be due to infectious agents but to non-infectious airway inflammation caused by allergies or inhalation of pollutants and cold dry air. The amount of physical activity that a person does influences his/ her risk of infection, most likely by affecting immune function (Matthews, 2002). Immune system of people who participate in physical activities is usually more functional than that of people who are sedentary.

To further understand the links between physical activity and optimum immune system, a group of researchers, from the Appalachian State University and the University of North Carolina in a study followed a group of 1002 healthy adults aged from 18 to 85 years, over a 12-week period during the US autumn and winter seasons in 2008. At the beginning of the study, the subjects were examined, and questioned on their diet and lifestyle, including how much exercise they did and how fit they perceived themselves to be. Then, every day over 12 weeks, each participant reported any symptom of respiratory illness they experienced (such as sneezes, coughs, fever or other symptoms) and its severity, according to a standardized scale called the Wisconsin Upper Respiratory Symptom Survey. Over the 12 weeks, the subjects reported experiencing symptoms of an upper respiratory tract illness (URTI) on average for 13 days in the winter and 8 days in the autumn. But those who were fit and exercised frequently were much less likely to develop a cold, and when they did, it was much less severe. According to the result of the study, those in the top quarter for fitness levels (who did five or more days of exercise a week) experienced 43 percent fewer days with URTI symptoms than those in the lowest 25 percent of fitness levels (who did one day or less of exercise). And when they did get cold symptoms, the symptoms were less severe. URTI symptoms were 32 percent less severe in the top 25 percent of exercisers compared to the bottom 25 percent. (The researchers adjusted for various other factors that can affect immune response such as mental stress, lack of sleep, poor nutrient status, and old age.).

Previous studies have also shown this relationship between fitness and reduced incidence and/or severity of URTI symptoms, the researchers say. Also, according to the researchers, exercise appears to reduce URTI incidence anywhere from 18 to 67 percent, depending on the study. The precise nature of the link between exercise and increased immunity remains a mystery, but it could be that each bout of exercise causes a transient increase in

immune system activity, increasing the numbers of white blood cells and immunoglobulin in the blood, which acts to reduce a person¹s susceptibility to disease the researchers suggest. As a general rule the healthier you are, the easier you'll find it is to fight off infections. People who exercise regularly have lower levels of stress hormones in the blood, and there's a link between low levels of stress hormones and improved immunity. This is also true for the elderly, because optimum immunity makes the ageing process more graceful.

One of the most recognized consequences of ageing is a decline in immune function. While elderly individuals are by no means immunodeficient, they often do not respond efficiently to novel or previously encountered antigens. Thompson, (2003) stated that this is illustrated by increased vulnerability of individuals 70 years of age and older to influenza, a situation that McElhaney and Dutz (2008) opined is exacerbated by their poor response to vaccination. As people age, the immune system becomes less effective. According to Delves (2017), ageing affects the immune system in the following ways;

- The immune system becomes less able to distinguish self from non-self (that is, to identify foreign antigens). As a result, autoimmune disorders become more common.
- Macrophages (which ingest bacteria and other foreign cells) destroy bacteria, cancer cells, and other antigens more slowly. This slowdown may be one reason that cancer is more common among older people.
- T cells (which remember antigens they have previously encountered) respond less quickly to the antigens.
- There are fewer white blood cells capable of responding to new antigens. Thus, when older people encounter a new antigen, the body is less able to remember and defend against it.
- Older people have smaller amounts of complement proteins and do not produce as many of these proteins as younger people do in response to bacterial infections.

Although the amount of antibody produced in response to an antigen remains about the same overall, the antibodies become less able to attach to the antigen. This change may partly explain why pneumonia, influenza, infective endocarditis, and tetanus are more common among older people and result in death more often. These changes may also partly explain why vaccines are less effective in older people and thus why it is important for older people to get booster shots (which are available for some vaccines). According to Delves (2017), these changes in immune function may contribute to the greater susceptibility of older people to some infections and cancers. Fortunately, being physically active helps reduce the adverse effects of ageing on the immune system. The World Health Organization (WHO 2007) published guidelines on the importance of physical activity in elderly people. According to these guidelines, exercise is an efficient and cost-effective way of preventing the decline of older people's functional capacity. Physical activity can help in preventing and managing certain chronic diseases and conditions. Strength, balance and flexibility exercises are the most effective strategies to prevent falls among older adults. The positive effects of physical activity are longer independency in self-care activities, higher self-esteem, better quality of life, higher life expectancy, decreased mortality and an efficient immune system.

Physical Activities for the Elderly

Physical activities have been shown to slow down the negative effects of ageing to the body cells and tissues. Elderly persons should try to avoid inactivity because some health benefits can occur with any amount of physical activity gain. Older adults need to evaluate their level of fitness before determining their level of effort for physical activity. Chronic conditions need to be taken into consideration since they may affect their ability to do regular physical activity safely. The United States National Institute on Ageing (2008) Physical Activity Guidelines recommend that older adults should incorporate aerobic activity, muscle-strengthening activity, and balance training for older adults especially those at risk for falls and other diseases.

- **Aerobic Activities**

Aerobic activity is also known as endurance activity and examples include: brisk walking, jogging, biking, dancing, and swimming. According to the Centre for Disease Control CDC (2012), older adults should aim for at least 150 minutes (2 hours and 30 minutes) of moderate-intensity aerobic activity each week, 75 minutes (1 hour and 15 minutes) of vigorous-intensity aerobic physical activity each week, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. When chronic conditions make it hard to achieve the 150 minutes each week, older adults should be physically active as their abilities and conditions allow. Perform aerobic activity for at least 3 days a week to help avoid excessive fatigue and reduce risk of injury. It counts as long as the aerobic activity is performed at a moderate or vigorous effort for at least 10 minutes at a time. The intensity of the activity depends upon the older adult's level of fitness. Examples of aerobic activities elderly persons can engage in includes; walking, dancing, swimming, water aerobics, jogging, aerobic exercise classes, bicycle riding (stationary or on a path), Some activities of gardening, such as raking and pushing a lawn mower, tennis, golf

(without a cart). These aerobic activities according to CDC (2012) increases cardiovascular fitness in the elderly. However, care should be taken in carrying out these activities especially when the individual has medical conditions like high blood pressure.

- **Muscle-Strengthening Activities**

Older adults should participate in muscle-strengthening activities at least 2 days a week while including all major muscle groups: the legs, hips, back, chest, abdomen, shoulders, and arms. One set of 8 to 12 repetitions of each exercise is effective, but doing two or three sets of 8 to 12 repetitions may be more effective. Examples of muscle-strengthening activities for older population includes: Exercises using exercise bands, weight machines, hand-held weights, Calisthenic exercises (body weight provides resistance to movement), Digging, lifting, and carrying as part of gardening, Carrying groceries, Some yoga exercises, Some tai chi exercises. In carrying out these activities, the elderly should be assisted by a younger individual to avoid sustaining injuries.

- **Balance Activities for Older Adults**

Older adults especially those at risk of falling should concentrate on exercises that maintain or improve balance. Increased risk of falling occurs when older adults have trouble walking or have had falls in the recent past. Participating in regular physical activity is not only safe for older adults, but it helps reduce the risk of falls. The guidelines recommend older adults to do balance training 3 or more days a week and do standardized exercises from a program demonstrated to reduce falls. Examples of balance exercises for the elderly includes: backward walking, sideways walking, heel walking, toe walking, standing from a sitting position. However, these exercises should be done with utmost care, in proper light clothing and with the guidance of an exercise specialist.

- **Flexibility Activities**

Even though flexibility does not have recommended guidelines, it is an important part of physical fitness. Flexibility plays an integral part in some types of physical activities such as dancing. Adults should perform stretching exercises to help increase flexibility. Activities that require greater flexibility is easier for adults who perform stretching exercises. Doing gentle stretches every day will help the muscles remain limber and improve the elderly's flexibility (Reznik, 2017). Stretching is particularly important before engaging in vigorous exercise, such as running, playing tennis or competing in pickup hoops, but it's beneficial every day regardless of your level of physical activity. However, these activities should be monitored by an exercise specialist so as to avoid muscle strain.

Conclusion

The effects of aging on the immune system are manifest at multiple levels that include reduced production of B and T cells in bone marrow and thymus and diminished function of mature lymphocytes in secondary lymphoid tissues. As a result, elderly individuals do not respond to immune challenge as robustly as the young. The effects of aging on the immune system are widespread and affect the rate at which naive B and T cells are produced as well as the composition and quality of the mature lymphocyte pool. Regular moderate exercise reduces the risk of infection compared with a sedentary lifestyle, but very prolonged bouts of exercise and periods of intensified training or competition are associated with increased risk of infection. Moderate bouts of physical activity tend to have an immune system boost that lasts for short periods of time after the activity has been completed. Regular physical activity, and associated high level physical fitness, is related to reduced incidence of upper respiratory tract infections including the common cold. Moderate activity can help those with some immune system disorders, maintain body weight, muscle mass, as well as contribute to an improved quality of life. Which is very important for healthy ageing especially among the elderly.

Recommendations

Based on the conclusions from this paper, it is recommended that;

1. Children and young people should achieve a total of at least 60 minutes of at least moderate-intensity physical activity each day as habits of wellness started at young age would have impact on the health and immunity of the individual later at old age.
2. For general health benefit, adults and the elderly should achieve a total of at least 30 minutes of at least moderate-intensity physical activity a day, on five or more days a week. This recommended level of activity can be achieved either by doing all the daily activities in one session, or through several shorter bouts of activity of 10 minutes or more. The activity can be lifestyle activity or structured exercise or sport, or a combination of these.
3. Members of communities should create conducive environment that will be particularly encouraging for the elderly to engage in physical activities.

4. Non-governmental organizations should always create awareness on the benefits of physical activities for healthy ageing.
5. Government should build and encourage the building of facilities for physical exercises that will be easily assessible to the elderly.

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