

REGULAR PHYSICAL EXERCISE: AN ANTIDOTE FOR HEALTHY AGEING

***¹ JOEL, Kerimu Ikazuwagbe, ² OGUGUA, John Ezebuilo & ³ AWOSIKA, Omolola Justinah**

¹Department of Human Kinetics Education, Faculty of Education.
University of Ilorin. Ilorin, Nigeria

^{2,3}Department of Human Kinetics and Health Education
University of Nigeria, Nsukka

*Corresponding Author: joel.ki@unilorin.edu.ng/+234(0)8026198960

Abstract

Aging is an inevitable phenomenon in every living thing and as human advance in age to older adulthood, which is associated with the occurrence of chronic non-communicable diseases especially in developing countries, of which Nigeria is one. Despite the abundance of information by researchers, participation in physical activities remains low amongst older adults in developing countries, especially those living in urban areas. Regular physical exercise has proved to be an essential (antidote) for total wellbeing of individuals irrespective of age. Evidence shows that regular physical exercise is safe for healthy and mobility of older people and the risks of developing chronic non-communicable diseases such as cardiovascular and metabolic diseases, obesity, falls, type 2 diabetes, stroke, sarcopenia, cognitive impairments, osteoporosis are reduced by regularly engaging in exercise ranging from low intensity walking through, more vigorous sports and resistance exercise. Based on the outcome of the reviewed, it was recommended that, older people should be encouraged to increase their participation in physical activities which will in turn promote their health status and healthy ageing. Adults should partake in at least two strength-training sessions a week that will improve the body's major muscle groups for healthy ageing. Older people between 50 years and above should engage in at least 150 minutes of moderate intensity physical activity a week, while people who engage in more vigorous intensity exercise, such as jogging, should aim for 10-15 minutes, three days a week.

Keywords: Regular, Physical-exercise, Healthy, Ageing, Antidote

Introduction

Ageing is an inevitable, irreversible and a natural phenomenon. Omotara et al. (2015) noted that in sub-Saharan Africa, the population of elderly persons is estimated to rise from about 37.1 million in 2005 to 155.4 million in 2050. While that of Nigeria is also growing rapidly. According to Balcombe (2001) ageing refers to any time-related process and is a continuous process that starts at conception and continues until death. João (2013) defined ageing as a progressive deterioration of physiological function, an intrinsic age-related process of loss of viability and increase in vulnerability. People prefer to experience active and healthy ageing as ageing presents both challenges and opportunities. WHO (2018) stated that ageing increase demand for primary health care and long-term care, require a larger and better trained workforce and intensify the need for environments to be made more age-friendly. Akosile et al. (2014) noted that ageing is associated with increased morbidity, increased fear of falling (FOF) and reduced activity.

The attention towards older adults in most developing countries, especially in Africa has always been within the extended family system. Conversely, the system is under severe pressure due to poor economic condition that is worsened by lack of employment for adult children in Africa (Togonu-Bickersteth and Akinyemi, 2014). WHO (2010) and Zarem (2010) as cited in Ejechi & Ogege (2015) stated that elders in many developing countries live in abject poverty that is worsened by significant prevalence of communicable and non-communicable diseases. Unlike in high income countries where social security and community care centres exist for older adults, care for the elderly is largely undertaken by the family in Nigeria and many sub-Saharan African countries except South Africa.

One of the significant ways the burden of old age can be relieved is to promote healthy behavior that facilitates healthy ageing in order to reduce the cost of medical care and mortality. According to WHO (2002) and Abegunde et al. (2007) about 2 million deaths per year are attributable to physical inactivity worldwide, and more than 80% of deaths from chronic diseases occur in developing countries. Partaking in regular physical exercise has proved to enhance health or serves as an antidote for one's overall health and fitness, and reduces chances of many chronic diseases in elderly people. Shrivastava et al. (2013) asserted that health promoting activities such as regular exercise by adults strengthens the body and immune system and also prevent geriatric diseases.

Assah et al. (2011) and Ejechi (2013) as cited in Ejechi and Ogege (2015) suggested that physical activity in African rural setting are considered higher because of farming, hunting and fishing, which continues till old age. Though, information on other forms of physical activity among urban-dwelling older adults in Nigeria and indeed sub-Saharan Africa is limited. Indeed it is arguable that modernization introduced physically inactive life in Africa because of white collar and paid jobs where people sit in offices or remain in shops all day. Urbanization may have further compounded the problem by increasing the population of physically inactive people (Ejechi and Ogege, 2015). Furthermore, Ejechi and Ogege concluded in their findings on physical activity engagement among Nigeria adults between 50 – 65 years old, that more than 40% of the respondent did not meet the minimum physical activity requirement recommended by WHO (2010). While, in Oyeyemi et al. (2013) study conducted in Nigeria, it was observed that from the 934 adults between the ages of 20–84 years old, 68.6% engaged in physical activity sufficiently. Omotara et al. (2015) stated that among the rural elderly of North-Eastern Nigeria, physical activity is significantly associated with healthy ageing.

Regular physical exercise has been discovered from research as an antidote for healthy ageing. However, there are many older adults who live a sedentary lifestyle. Hence, this paper will consider regular physical exercise as an antidote for healthy ageing.

Physical Exercise

Physical exercise generally promotes healthy lifestyle among older adults. Regular exercise provides a myriad of health benefits in older adults, including improvements in blood pressure, diabetes, lipid profile, osteoarthritis, osteoporosis, and neurocognitive function (Siddiqui et al. (2010) stated that any bodily activity or movement that enhances and maintains overall health and physical fitness is called physical exercise. WHO (2009) stated that "exercise" and "physical activity (PA)" are often 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. However, PA is not exactly the same concept as

exercise. Exercise is defined as a subsection of PA that is planned, structured, repetitive, and purposeful towards the improvement or maintenance of one or more components of physical fitness. PA 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 exercise is intentional and deliberate act of engaging the human body physically. The use of “SMART” heuristic (Doran, 1981), which means “Specific, Measurable, Achievable/Attainable, Realistic and Time-bound” can be used to describe physical exercise as PA that are “SMART”, that is, PA that are “Specific”, PA that are “Measurable”, PA that are “Achievable/Attainable”, PA that are Realistic, and PA that are “Time-bound”. Therefore, frequent and regular physical exercise is important in the prevention of some diseases such as heart disease, cardiovascular disease, Type 2 diabetes, Arthritis, obesity, sarcopenia, among others. Beyond exercise, any bodily movement that is done during leisure time, for transport to get to and from places or as part of a person’s chores, has a significant benefit to health and also improves one’s healthy ageing.

De Souza Teixeira et al. (2020) noted that the lifelong practice of regular physical exercise slows the processes of aging, providing better quality and prolongation of life. They further, find out that physical exercise is associated with a lower rate of developing chronic diseases, such as cardiovascular disease, type 2 diabetes mellitus, sarcopenia, obesity, and others. Whereas, Rebelo-Marques et al. (2018) asserted that physical exercise is free, reduces the risk of many potentially chronic diseases, and reduces sedentary behavior and physical-inactivity. They also stated that older adults must engage in physical exercise to maintain the health-related quality of life and functional capabilities that alleviate physiological changes and comorbidities associated with aging. Broman and Kelso (2012) identified physical activity/exercise as effective stress management practices. The practices help to reduce stress and maximize the likelihood of living a long life; reduced risk for some chronic diseases such as high blood pressure, improve mood, and decrease negative emotions. Physical exercise from the above mentioned, is a necessity for every older individual to enjoy healthy ageing.

Healthy Ageing

Since WHO has emphasized that every person in every country in the *world* should have the opportunity to live a **long and healthy life**, it is necessary that conducive environment be created for such. WHO (2018) defined healthy ageing as the process of developing and maintaining the functional ability that enables wellbeing in old age, with functional ability determined by the inherent capacity that enable all people to be and do what they have reason to value. This includes a person’s ability to:

- meet their basic needs;
- to learn, grow and make decisions;
- to be mobile;
- to build and maintain relationships; and
- to contribute to society.

Regular physical exercise helps one to meet the above-mentioned functional ability which is made up of the **intrinsic capacity** of the individual, relevant **environmental characteristics** and the interaction between them as they all lead to healthy ageing. The healthy ageing project (2006) defined healthy ageing as the process of optimizing opportunities for physical, social and mental health to enable older people to take an active part in society without

discrimination and to enjoy an independent and good quality of life. The above definition takes into account equity in health and an independent life of good quality.

Theories of Healthy Ageing

This paper anchored on two theories, The Activity theory and Continuity Theory. The activity theory, also known as the implicit theory of aging, normal theory of aging, and lay theory of aging, which proposes that successful ageing occurs when older adults stay active and maintain social interactions. It takes the view that the aging process is delayed and the quality of life is enhanced when old people remain socially active. The activity theory rose in opposing response to the disengagement theory. The activity theory and the disengagement theory were the two major theories that outlined successful ageing in the early 1960s. The activity theory was developed by Robert J. Havighurst in 1961. In 1964, Bernice Neugarten asserted that satisfaction in old age depended on active maintenance of personal relationships and endeavors.

The Continuity theory was formerly proposed in 1971 by Robert. C. Atchley in his article "Retirement and Leisure Participation: Continuity or Crisis?" In the journal the gerontologist. Later, in 1989, he published another article titled "A Continuity Theory of Normal Aging, in the gerontology in which he substantially developed the theory. In this article, he expanded the continuity theory to explain the development of internal and external structures of continuity. The theory deals with the internal structure and the external structure of continuity to describe how people adapt to their situation and set their goals. The internal structure of an individual such as personality, ideas, and beliefs remain constant throughout their lives. This provides the individual a way to make future decisions based on their internal foundation of the past. The external structure of an individual such as relationships and social roles provides a support for maintaining a stable self-concept and lifestyle.

Exercise prescription for the ageing

Since several researches have clearly justified physical exercise as an antidote for healthy ageing, the need to determine the exercise prescription for the ageing is very imperative. Prescribed exercise is potent countermeasures against unhealthy aging and also plays a major role in the prevention of chronic diseases (Booth et al., 2002). Nied and Franklin (2002) advised that before introducing an exercise program for the ageing, older adults should undergo a history and physical examination focused at identifying cardiac risk factors, exertional signs/symptoms, and physical limitations. They further explained that even patients with these conditions can safely exercise at low intensity once appropriate evaluation and treatment have been initiated. Exercise recommendations for a given individual will depend on existing comorbidities and on the baseline level of physical activity. Initially, sedentary individuals should begin at a very low intensity and gradually progress to a goal of moderate intensity activity.

WHO (2010) recommended that adults should do at least 150 minutes of moderate-intensity physical activity (MVPA) throughout the week or do at least 75 minutes of vigorous-intensity (VA) physical activity throughout the week or an equivalent combination of moderate and vigorous intensity activity (MVPA).

Conversely, Nied and Franklin (2002) stated that the exercise prescription consists of three components: aerobic exercise, strength training, and balance and flexibility. They further explained that aerobic exercise (cardiovascular exercise) should include moderate aerobic activity for least 30 minutes, in most days of the week. Also, the strength training should consist of a

single set of 10 to 15 repetitions using eight to 10 different exercises, performed two to three times per week. Each repetition should be performed slowly through a full range of motion while avoiding holding one's breath. The training program should involve all major muscle groups. While, the balance and flexibility training should include stretching major muscle groups once per day after exercise when muscles are more compliant. Balance training and weight transfer program twice per week.

Physical exercise for older adult should include aerobic exercise, muscle strengthening and endurance training, and flexibility and neuromotor exercises. Physical exercise strain and intensity progression should be tailored to the individual's tolerance, preference, and specific needs. Thus, lighter intensity and duration are recommended at earlier stages, especially for those who are deconditioned or functionally impaired or present chronic conditions that preclude the performance of more demanding physical tasks ACSM (2018). While, Klimova and Dostalova (2020) indicated that the most appropriate physical activities for cognitive maintenance in adults are walking, running, aerobic exercise, nordic walking, swimming, virtual cycling, and strength training activities.

Stretching exercise is an essential exercise routine for older adults. It increases joint mobility and function, and decreases joint stiffness and pain. Stretching all major muscle groups and joint areas regularly promote good alignment and balance. Regular stretching decreases anxiety, blood pressure, and breathing rate, which help to relax muscles and aches and pains related to neuromuscular tension (stress). Stretching also improve flexibility, which relieves muscle cramps that may occur during exercise or participation in sports (Flynn et al. 2018). Walking at a brisk pace has proved to be a good form of cardiovascular exercise for older adults. Kang et al. (2018) stated that promoting walking for transport provides a potential strategy for increasing physical activity level and improving or maintaining physical fitness and overall health.

Cycling is a healthy form of exercise for the elderly, also providing cardiovascular exercise. Cycling is a transport mode that effectively tasks the cardiorespiratory and metabolic functions of the whole body in a wide range of intensities and thus lends itself to many potential health benefits (Oja, et al., 2011). WHO (2002) ascertained that individual with a low initial fitness level, a single trip distance of 3 km per day on at least 4 days per week is enough to improve physical performance. Therefore, the extreme health gains can be achieved when the least active individuals become moderately active. Gerber, et al., (2011) concluded that adults must adhere to the prescribed physical activity or exercise regimen and follow the overload principle of training.

Benefits of Physical Exercise to Ageing

According to Nied and Franklin (2002) regular exercise provides a myriad of health benefits in older adults, including improvements in blood pressure, diabetes, lipid profile, osteoarthritis, osteoporosis, and neurocognitive function. Some of the most prominent effects of ageing may be mitigated by regularly exercising. Exercising has numerous benefits for older people because of its ability to increase balance, increase flexibility, increase mobility and lower blood pressure. It also helps people maintain a healthy weight and reduce their chances of developing diseases and disabilities. Exercise has positive effect on heart and brain. A study reported by the Gerontological Society of America (2018) found that fitness training led to significant increases in brain volume in people between 60 and 79 years old. Regular exercises

also help in treating several chronic health conditions, including arthritis, diabetes and heart disease. Exercising may even have the potential to increase lifespan, and three hours of exercise each week could possibly extend a person's life by five years. According to Health in Aging Foundation (2018), engaging in regular physical exercise weekly improves health in the following ways:

Promotes Mental and Cognitive Health: Physical activity can help reduce feelings of depression and anxiety. Exercise triggers the release of "feel-good" brain chemicals, which can lift your spirits and ease depression. You may also find out that being active optimizes your cognitive function and helps keep your mind sharp.

Increases Physical Strength: Older adults who are physically active build and maintain healthy bones, muscles, and joints. They may be more secure on their feet and better able to move about without falling, which decreases the likelihood and severity of falls. Simple strength and balanced training exercises can reduce your risk of falls by 40%.

Helps Maintain a Healthy Weight: Increased weight can be a factor in a number of health problems. Physical activity can help keep your weight at a healthy level. In case you lose weight through dieting, physical activity, particularly muscle-strengthening activity, can preserve bone and muscle mass.

Restores Restful Sleep: Physically active man will enjoy a sound sleep. Being active also decreases your feelings of tiredness and fatigue. Engagement in adequate aerobic exercise early evening can improve sleep quality.

Reduces Arthritic Disability: Studies have shown that older adults with osteoarthritis had less pain and more flexibility after 16 weeks of strengthening exercises.

Maintains or Improves Heart Function: Physical activity helps your heart work more efficiently. Aerobic exercise (the kind that makes you breathe faster) can improve the fitness of your heart within 6 weeks after beginning an exercise program which also increases the heart volume.

Improve Blood Sugar Control: Better control of sugar levels means you may need less medication to reduce diabetes. Regular physical exercises can also decrease your risk of the long-term problems associated with diabetes.

Keep Bones Strong: After menopause, women can lose 1 to 2% of their bone mass every year. The good news is that doing strength-training exercises can increase bone density and reduce an older woman's risk for bone fractures. Starting an exercise program even late in life can help to preserve bone density.

Roles of Physical Exercise in Healthy Ageing

Regular physical exercise helps to improve physical and mental functions as well as reverse some effects of chronic diseases in aged people. Despite the highly publicized benefits of physical exercise, the overwhelming majority of older people do not meet the minimum physical exercise levels needed to maintain health. McPhee et al. (2016) pointed out that the sedentary lifestyles that dominant old age results in premature onset of ill health, disease and frailty.

Evidence shows that regular physical exercise ensures healthy older people and prevents the risks of developing some cardiovascular and metabolic diseases, obesity, falls, cognitive impairments, osteoporosis and muscular weakness. The problems associated with lack of exercise are reduced by regularly engaging in activities ranging from low intensity walking through to more vigorous sports and resistance exercises. Booth et al. (2000) and Lee et al. (2012) stated that

inactivity is the major cause of poor physiological fitness and disease in older age. Sedentary people aged 50 years and older had twice the risk of death compared with those who had the highest level of physical activity after adjusting for a range of risk factors (including age and socio-economic position) (Nazroo et al., 2008). Feldman et al. (2015) stated that people with higher physical activity levels and physiological fitness have a lower mortality risk. Therefore, maintenance of a physically active lifestyle through middle and older age is associated with better health in old age. But, it is never too late for those who were relatively sedentary through middle age, because beginning a new exercise regimen in old age leads to significant improvements to health (Berk et al., 2006 & Hamer et al., 2014) and cognition (Lautenschlager et al., 2008).

Physical activity reduces the risk of developing cardiovascular and metabolic disease through better control of blood pressure, cholesterol and waist circumference in a dose-dependent manner (Earnest et al., 2013). The metabolic benefits of increasing fatty acid oxidation in skeletal muscle, rather than accumulating intramuscular and adipose tissue stores around the major organs as well as lowered blood pressure helps to reduce the risk of developing type 2 diabetes mellitus and cardiovascular disease (Roberts et al., 2013 & Stewart et al., 2005). According to Lautenschlager et al. (2008) regular exercise helps to maintain cognitive function and possibly the numbers of peripheral motor neurons controlling leg muscles and improves balance and coordination to reduce risk of falls. In case fall occur, people who exercise regularly are less likely to suffer a bone fracture because their bones are stronger and have higher bone mineral density (Ireland et al., 2014).

Older people who maintained regular jogging postponed disability by almost 9 years and had three times lower risk of death compared to those who had never been a member of a running club (Wang et al., 2002). The risk of developing cardiovascular disease is also low in those engaging in regular fitness exercise compared with moderate intensity exercise (Swain & Franklin 2006). Thus, there appears to be a dose-response relationship to indicate that higher intensity activities bring greater health benefits (Bruce et al., 2008; Ebrahim et al., 2000; & Kim et al., 2013), but it is important to note that older people must be suitably adapted to participate in the prescribed highly intensified activities, so that the relationship might reflect the overall exercise history.

Conclusion

Regular physical exercise is essential for total wellbeing of an individual irrespective of age. Evidence shows that regular physical exercise improves quality of life and promotes health and wellbeing of old people or the aged. Physical exercise reduces the risks of developing chronic NCDs, such as cardiovascular and metabolic diseases, obesity, falls, cognitive impairments, osteoporosis and muscular weakness. It has been observed from the review that regular physical exercise is an antidote for healthy ageing as it can minimize the physiological changes associated with typical aging in a sedentary society as well as contribute to psychological health and well-being; increases longevity and decreases the risk of many common chronic diseases; may be used as primary or adjunctive treatment for certain chronic diseases and may counteract specific side effects of standard medical care and may be used as primary or adjunctive treatment for certain chronic NCDs.

Exercise prescription should depend on existing comorbidities and individuals physical exercise base line. Exercise prescription for older adult should be done considering their health history. Also, before engaging in exercise older adults should undergo a history and physical

examination focused at identifying cardiac risk factors, exertional signs/symptoms, and physical limitations. Older adults with functional capacity challenges because of health status should not imbibe sedentary lifestyle, rather engaged in moderate exercise in proportionate to their functional capacity.

Recommendations

- Adults should partake in at least two strength-training sessions a week that will improve the body's major muscle groups for healthy ageing.
- Older people between 50 years and above should engage in at least 150 minutes of moderate intensity physical activity a week, while people who engage in more vigorous intensity exercise, such as jogging, should aim for 10-15 minutes, three days a week.
- A specialized community physical exercise center should be created for the elderly to engage in exercise within their community.
- Family physicians should encourage and motivate their older patient to engage in Physical exercise.

References

- Abegunde, D. O., Mathers, C. D., Adam, T., Ortegon, M., & Strong, K. (2007). *The burden and costs of chronic diseases in low-income and middle-income countries*. Lancet (London, England). Retrieved from [https://doi.org/10.1016/S0140-6736\(07\)61696-1](https://doi.org/10.1016/S0140-6736(07)61696-1)
- Akosile, C. O., Anukam, G. O., Johnson, O. E., Fabunmi, A. A., Okoye, E. C., Iheukwumere, N., & Akinwola, M. O. (2014). Fear of falling and quality of life of apparently-healthy elderly individuals from a Nigerian population. *Journal of Cross-cultural Gerontology*, 29 (2), 201–209.
- American College of Sports Medicine (ACSM). (2018). *ACSM's guidelines for exercise testing and prescription*: Lippincott Williams & Wilkins.
- Atchley, R. C. (1989). A continuity theory of normal aging. *The Gerontologist*, 29 (2), 183–190. doi:10.1093/geront/29.2.183.
- Balcombe, N. R., & Sinclair, A. (2001). Ageing: Definitions, mechanisms and the magnitude of the problem. *Best Practice & Research. Clinical Gastroenterology*, 15 (6), 835–849. <https://doi.org/10.1053/bega.2001.0244>
- Berk, D. R., Hubert, H. B., & Fries, J. F. (2006). Associations of changes in exercise level with subsequent disability among seniors: A 16-year longitudinal study. *J Gerontol Ser A*, 61 (1), 97 – 102. doi: 10.1093/gerona/61.1.97.
- Booth, F. W., Chakravarthy, M. V., Gordon, S. E., & Spangenburg, E. E. (2002). Waging war on physical inactivity: using modern molecular ammunition against an ancient enemy. *Journal of Applied Physiology*, 93 (1), 3 – 30. <https://doi.org/10.1152>
- Booth, F. W., Gordon, S. E., Carlson, C. J., & Hamilton, M. T. (2000). Waging war on modern chronic diseases: Primary prevention through exercise Biology. *Journal of Applied Physiology*, 88 (2), 774–787. <https://doi.org/10.1152/jappl.2000.88.2.774>
- Broman-Fulks, J. J. & Kelso, K. (2012). Stress management. Retrieved on April, 2021 from https://www.researchgate.net/profile/Joshua_BromanFulks/publication/273946086_Stress_Management/links/5510d20f0cf20352196ca48c/Stress-Management.
- Bruce, B., Fries, J. F., & Hubert, H. (2008). Regular vigorous physical activity and disability development in healthy overweight and normal-weight seniors: A 13-year study.

- American Journal of Public Health*, 98 (7), 1294–1299.
<https://doi.org/10.2105/AJPH.2007.119909>
- De Souza Teixeira, A. A., Lira, F. S., & Rosa-Neto, J. C. (2020). Aging with rhythmicity. Is it possible? Physical exercise as a pacemaker. *Life Sciences*, 261: 118-453.
<https://doi.org/10.1016/j.lfs.2020.118453>
- Doran, G.T. (1981). There's a S.M.A.R.T. way to write management's goals and objectives. *Management Review*, 70: 35-36
- Earnest, C. P., Johannsen, N. M., Swift, D. L., Lavie, C. J., Blair, S. N., & Church, T. S. (2013). Dose effect of cardiorespiratory exercise on metabolic syndrome in postmenopausal women. *The American Journal of Cardiology*, 111 (12), 1805–1811.
<https://doi.org/10.1016/j.amjcard.2013.02.037>
- Ebrahim, S., Wannamethee, S. G., Whincup, P., Walker, M., & Shaper, A. G. (2000). Locomotor disability in a cohort of British men: The impact of lifestyle and disease. *International Journal of Epidemiology*, 29 (3), 478–486. doi: 10.1093/ije/29.3.478.
- Ejechi, E. O & Ogege, S. O. (2015). Socio-demographic, health-related and physical environmental correlates of physical activity among urban-dwelling Nigerians in elderly old age. *Int J Dev. & Sustainability*, 4 (7), 789- 804.
- Feldman, D. I., Al-Mallah, M. H., Keteyian, S. J., Brawner, C. A., Feldman, T., Blumenthal, R. S., & Blaha, M. J. (2015). No evidence of an upper threshold for mortality benefit at high levels of cardiorespiratory fitness. *Journal of the American College of Cardiology*, 65(6), 629–630. <https://doi.org/10.1016/j.jacc.2014.11.030>
- Flynn, S., Jellum, L., Howard, J., Moser, A., Mathis, D., Collins, C., Henderson, S. & Watjen, C. (2018). Concepts of fitness and wellness, 2nd edition. *Nursing and Health Sciences Open Textbooks 4*. <https://oer.galileo.usg.edu/health-textbooks/4>
- Garber, C.E., Blissmer, B., Deschenes, M.R., Franklin, B.A., Lamonte, M.J., Lee, I.M., Nieman, D.C., Swain, D.P., (2011). Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *American College of Sports Medicine. Medicine and Science in Sports Exercise*, 43(7), 1334-59.
- Gerontological Society of America (2018). Retrieved 30th August 2019 from <https://gerontology.usc.edu/resources/infographics/necessity-exercise-physical-activity-and-aging/>
- Hamer, M., Lavoie, K. L., & Bacon, S. L. (2014). Taking up physical activity in later life and healthy ageing: The English longitudinal study of ageing. *British Journal of Sports Medicine*, 48(3), 239–243. <https://doi.org/10.1136/bjsports-2013-092993>
- Health in Aging Foundation (2018). Retrieved 28th August 2019 from <http://www.healthinaging.org/aging-and-health-a-to-z/topic:physical-activity/>
- Ireland, A., Maden-Wilkinson, T., Ganse, B., Degens, H., & Rittweger, J. (2014). Effects of age and starting age upon side asymmetry in the arms of veteran tennis players: A cross-sectional study. *Osteoporosis International: A journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA*, 25(4), 1389–1400. <https://doi.org/10.1007/s00198-014-2617-5>
- João, P. M. (2013). *Ageing definition*. Retrieved on 23th July, 2019 from <http://www.senescence.info/aging-definition.html>

- Kang, B., Moudon, A. V., Hurvitz, P. M. & Sealens, B. E. (2018). Increased walking additive and no substitution effect on total physical activity. *Medical and Science in Sports and Exercise*, 50(3), 468-475. <http://doi.org/10.1249/mss.0000000000001450>
- Kim, L.G., Adamson, J., & Ebrahim, S. (2013). *Influence of life-style choices on locomotor Disability, arthritis and cardiovascular disease in older women*. Prospective Cohort Study. 42(6), 696–701. <https://doi.org/10.1093/ageing/aft127>
- Klimova, B., & Dostalova, R. (2020). The impact of physical activities on cognitive performance among healthy older individuals. *Brain Sciences*, 10: 37 - 47. 10.3390/brainsci10060377.
- Lautenschlager, N.T., Cox, K.L., Flicker, L., Foster, J.K., Van Bockxmeer F.M., Xiao, J., Greenop, K.R., & Almeida, O.P. (2008). Effect of physical activity on cognitive function in older adults at risk for Alzheimer disease: A randomized trial. *J Am Med Assoc.*; 300 (9), 1027–1037. <https://doi.org/10.1001/jama.300.9.1027>
- Lee, I.M., Shiroma. E.J., Lobelo. F., Puska. P., Blair, S.N., & Katzmarzyk, P.T. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *Lancet (London, England)*, 380 (9838), 219–229. [https://doi.org/10.1016/S0140-6736\(12\)61031-9](https://doi.org/10.1016/S0140-6736(12)61031-9)
- McPhee, J. S., French, D.P., Jackson, D., Nazroo, J., Pendleton N, & Degens, H. (2016). Physical activity in older age: Perspectives for healthy ageing and frailty. *Biogerontology*, 17 (3), 567–580. <https://doi.org/10.1007/s10522-016-9641-0>
- Nazroo, J., Zaninotto, P., & Gjonça, E. (2008). *Mortality and healthy life expectancy. living in the 21st century: Older people in England*. London: The Institute for Fiscal Studies.
- Nied, R. J., & Franklin, B. (2002). Promoting and prescribing exercise for the elderly. *American Family Physician*, 65 (3), 419–426.
- Oja, P., Titze, S., Bauman, A., de Geus, B., Krenn, P., Reger-Nash, B. & Kohlberger, T. (2011). Health benefits of cycling: A systematic review. *Scandinavian Journal of Medicine and Science in Sports* · DOI: 10.1111/j.1600-0838.2011.01299.
- Omotara, B. , Yahya, S. , Wudiri, Z. , Amodu, M. , Bimba, J. and Unyime, J. (2015). Assessment of the determinants of healthy ageing among the rural elderly of North-Eastern Nigeria. *Health*, 7: 754-764. doi: 10.4236/health.2015.76090
- Oyeyemi, A. L., Oyeyemi, A. Y., Jidda, Z. A., & Babagana, F. (2013). Prevalence of physical activity among adults in a metropolitan Nigerian city: A cross-sectional study. *Journal of Epidemiology*, 23 (3), 169–177. <https://doi.org/10.2188/jea.je20120116>
- Rebello-Marques, A., De Sousa Lages, A., Andrade, R., Ribeiro, C.F., Mota-Pinto, A., Carrilho, F; & Espregueira-Mendes, J. (2018). *Aging hallmarks: The benefits of physical exercise*. doi: 10.3389/fendo.2018.00258
- Robert J. H. (1961). Successful aging, *The Gerontologist*, 1: 8–13, <https://doi.org/10.1093/geront/1.1.8>
- Roberts, C. K., Hevener, A.L. & Barnard, R.J. (2013). Metabolic syndrome and insulin resistance: Underlying causes and modification by exercise training. *Comprehensive Physiology*, 3(1), 1–58. <https://doi.org/10.1002/cphy.c110062>
- Shrivastava, S. R., Shrivastava, P. S., & Ramasamy, J. (2013). Health-care of elderly: Determinants, needs and services. *International Journal of Preventive Medicine*, 4 (10), 1224–1225.
- Siddiqui, N.I., Nessa, A, & Hossain, M.A. (2010). Regular Physical Exercise: Way to Healthy Life. *Mymensingh Med J. Jan*; 19,(1),:154-8. Review.PMID:20046192.

- Stewart, K.J., Bacher, A.C., Turner, K., Lim, J.G., Hees, P.S., Shapiro, E.P., Tayback, M., & Ouyang, P. (2005). Exercise and Risk Factors Associated with Metabolic Syndrome in Older Adults. *Am J Prev Med*; 28(1), 9–18. <https://doi.org/10.1016/j.amepre.2004.09.006>
- Swain, D.P., & Franklin, B.A. (2006). Comparison of cardioprotective benefits of vigorous versus moderate intensity aerobic exercise. *Am J Cardiol*; 97 (1), 141–147. <https://doi.org/10.1016/j.amjcard.2005.07.130>
- The Healthy Ageing Project (2006). A Challenge for Europe http://ec.europa.eu/health/ph_projects/2003/action1/docs/2003_1_26_frep_en.pdf: accessed 29 July 2018
- Togonu-Bickersteth, F. and Akinyemi, A. (2014). Ageing and national development in Nigeria: Costly assumptions and challenges for the future. *African Population Studies*, 27 (2), 361 – 371.
- Wang, B.W., Ramey, D.R., Schettler ,J.D., Hubert, H.B., & Fries, J.F. (2002). Postponed development of disability in elderly runners: A 13-year Longitudinal Study. *Arch Intern Med.*, 162 (20), 2285–2294. doi: 10.1001/archinte.162.20.2285.
- World Health Organization (2002). *Reducing risks, promoting healthy life. World health report 2002*. Geneva: World Health Organization
- World Health Organization (2009). *Global Recommendations on physical activity for health*. Retrieved from 30th November, 2018 from <http://www.who.int/ncds/prevention/physical-activity/en/>
- World Health Organization (2018). *Definition of healthy ageing*. Retrieved 26th August 2018 from <http://www.who.int/ageing/en/>
- World Health Organization (2010). Global recommendations on physical activity for health.
- World Health Organization (2002). Reducing risks, promoting healthy life. Geneva: World Health Organization.