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AYURVEDIC & CURRENT PERSPECTIVES OF PHYSICAL EXERCISE (*VYAYAMA*) IN THE LIGHT OF HEALTH BENEFITS

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Abstract: *Physical exercise is considered as one of the most important aspects of preventive medicine in recent years, which is comparable to the Vyayama of Ayurvedic lexicons. Various aspects of Vyayama such as features of adequate exercise, indication, contraindication etc have been described in detail in Ayurveda. Physical exercise is considered as an important for maintaining physical fitness including healthy weight; building and maintaining healthy bones, muscles, and joints; promoting physiological well-being; reducing surgical risks; and strengthening the immune system. Recent evidences have been found about the positive association between increasing physical activity and desirable health effects. A directive of physical guidelines designed to in tune physical exercise in youth age, middle age and elderly age group; keeping nature and duration of exercise in mind. Findings of researches summarized in this context emphasizes that most of them are conducted in Western countries and the basic tenets of Vyayama available in Ayurveda. Ayurveda strongly believes that impact of any means and measures, which applied on human body, exerts distinct diverse actions due to culture, beliefs, genetic makeup, body built, health practices, and behaviors in the highly diverse groups. Current health issues of physical exercise in the cases of obesity, diabetes, coronary heart disease, cancer, osteoporosis, and so on, are well documented in biomedical sciences. This paper reviews what is known about physical exercise and its impact on health in various ways.*

Keywords: *physical activity, Ayurvediya vyayama, Aging, impact on health, excessive exercise.*

Introduction: In recent years, the dimensions of physical exercise have multifaceted approach ranging from health benefits to the treatment of various ailments and it is emerged as an important tool in the prevention of ailments in preventive medicine. *Vyayama* of Ayurveda is comparable to the physical exercises of contemporary concept of Physical Education. Acharya Charaka at several places in his treatise *Charaka Samhita*, has emphasizes the need of graduated physical exercise for restoring the health of unhealthy persons and patients. He defines *Vyayama* as the performance of such exercise as would give courage to the mind and strength and steadiness to the muscles. These exercises are to be performed cautiously, according to the measures of one's strength. Charaka has described in detail about exercise in the first section of *Sutrasthana* and in the chapter on 'Non suppression of natural urges'. Exercise defined, as "such a physical action, which is desirable and is capable of bringing about bodily stability and strength is known as physical exercise. This has to be practiced in moderation". This definition is very much modern and it might be the world's first definition of exercise, which is percolated from the world's oldest record of medical practice. Charaka was the first who gave the idea of the maintenance of positive health where it includes proper diet, sleep, rest, active habit, regular exercise etc.. He described body, mind and soul, these three are like a tripod; the human is sustained by their combination, they constitute the substratum for everything. He clearly suggested *Vyayama* (physical exercise) for the body and Yoga for mind and soul [1,2].

Sushruta defines *Vyayama* or physical exercise, is another ancient authority of Indian medicine, as follows: "Any act that causes fatigue to the body is known as *Vyayama*. Commentators of the *Sushruta samhita* have been given the following definition: "swinging

heavy weights called *Santolas* (each weighing 10 or 20 pounds), *Gunakarsha* (pulling bowstrings), *Dhanurakarsha* (bending bows) and bending of body in various directions by regular physical exercise is called *Vyayama*". *Charya* is defined as the practice of exercises involving the use of swords and arrows while riding on elephants, horses and chariots or in making quick marches on foot [3].

Sushruta definition of *Vyayama* appears most simple and contemporary to the present context of physical exercise, as he says that it is enough if any actions or movements of his body resulting in vigorous circulation of his blood and quick respiration tire the individual. If one is compelled to open, his mouth while doing any exercise, then is the time for him to consider that one half of his strength is exhausted [4,5]. Physical exercise is defined as any bodily activity that enhances or maintains the physical fitness and overall health and wellness. It is performed for various reasons, including strengthening of muscles and the cardiovascular system, honing athletic skills, weight loss or maintenance of body weight, and merely enjoyment. Frequent and regular physical exercise boosts the bodily immune system and helps in preventing the diseases of affluence such as heart diseases, cardiovascular disorders, Type 2 DM, and obesity [6,7]. It may also helps to prevent depression, promote or maintain positive self-esteem, improve mental health and can augment an individual's sex appeal or body image, which has been found to be linked with higher levels of self-esteem. Childhood obesity is a growing global concern, and physical exercise may help to decrease some of the effects of childhood and adult obesity. Health care providers often call exercise the "miracle" or "wonder" drug—alluding to the wide variety of proven benefits that it can provide [8,9,10].

Types of Physical Exercise: Regular physical activity helps to improve overall health and fitness, and reduces the risk for many chronic diseases. Physical exercises are generally grouped into three, depending on the overall effect they have on the human body

1. Aerobic Exercise: Any physical activity uses large muscle groups and causes body to use more oxygen than it would while resting [10]. The goal of aerobic exercise is to increase cardiovascular endurance [11].

Moderate-intensity Aerobic Activity: It means working hard enough to raise the heart rate and break a sweat. One way to tell is that trainee will be able to talk, but not sing the words of favorite song. Followings are some examples of activities that require moderate effort:

- Walking fast
- Doing water aerobics
- Riding a bike on level ground or with few hills
- Playing doubles tennis
- Pushing a lawn mower

Vigorous-intensity Aerobic Activity: It means breathing hard and fast and the heart rate has gone up quite a bit. If trainee working at this level, he will not be able to say more than a few words without pausing for a breath. Followings are some examples of activities that require vigorous effort:

- Jogging or running
- Swimming laps
- Riding a bike fast or on hills
- Playing singles tennis
- Playing basketball

2. Anaerobic Exercise: It is also called strength or resistance training and can firm, strengthen, and tone the body muscles, as well as improve bone strength, balance, and coordination. Examples of strength moves are pushups, lunges, and bicep curls using dumbbells. Anaerobic exercise also include weight training, functional training, eccentric training, interval training, sprinting etc. increase short-term muscle strength [10,12]

3. **Muscle Strengthening Activities:** Such types of exercises stretch and lengthen the body muscles. Activities such as stretching help to improve joint flexibility and keep muscles limber. The goal is to improve the range of motion , which can reduce the chance of injury [10,13].

Physical exercise can also include training that focuses on accuracy, agility, power, and speed. Sometimes the terms 'dynamic' and 'static' are used. 'Dynamic' exercises such as steady running tend to produce a lowering of the diastolic blood pressure during exercise, due to the improved blood flow. Conversely, static exercise such as weight lifting, working with resistance bands, heavy gardening, yogic practices etc. can cause the systolic pressure to rise significantly during the exercise.

Physical Activity Guidelines: Fitting regular exercise into daily schedule may seem difficult at the beginning, but the *Physical Activity Guidelines for Americans* (2008) are more flexible than ever, giving the freedom to reach

physical activity goals through different types and amounts of activities in each week. However, it does not include guidelines for children younger than 6 years old. Off course, this is necessary for healthy growth and development of children. Children younger than six should be physically active in ways appropriate for their age and stage of development [14].

Age Group between 6 to 17 Years: Children and adolescents should do 60 minutes or more of physical activity on each day. Following three types of exercises are recommended to this age group.

1. *Aerobic activity:* Aerobic activity should make up most of the child's 60 or more minutes of physical activity each day. This can include either moderate-intensity aerobic activity, such as brisk walking, or vigorous-intensity activity, such as running. Be sure to include vigorous-intensity aerobic activity on at least 3 days per week.
2. *Muscle strengthening:* Include muscle-strengthening activities, such as gymnastics or push-ups, at least 3 days per week as part of the child's 60 or more minutes.
3. *Bone strengthening:* Include bone-strengthening activities, such as jumping rope or running, at least 3 days per week as part of the child's 60 or more minutes.

Age Group between 18 to 64 Years: According to the *Physical Activity Guidelines for Americans 2008*, adults are required need to do two types of physical activity i.e. aerobic and muscle strengthening, in each week to improve overall health.

- 2 hours and 30 minutes (150 minutes) of moderate-intensity aerobic activity i.e., brisk walking every week &
- muscle-strengthening activities on 2 or more days a week that work all major muscle groups viz-legs, hips, back, abdomen, chest, shoulders, and arms.

  Or
- 1 hour and 15 minutes (75 minutes) of vigorous-intensity aerobic activity i.e., jogging or running every week and
- muscle-strengthening activities on 2 or more days a week that work all major muscle groups viz-legs, hips, back, abdomen, chest, shoulders, and arms.

  Or
- An equivalent mix of moderate- and vigorous-intensity aerobic activity &
- muscle-strengthening activities on 2 or more days a week that work all major muscle groups viz-legs, hips, back, abdomen, chest, shoulders, and arms.

Age Groups of 65 Years or > 65 Years

- Older adults need at least following types of physical exercise for their health benefits.
- 2 hours and 30 minutes (150 minutes) of moderate-intensity aerobic activity i.e., brisk walking every week **&**
- muscle-strengthening activities on 2 or more days a week that work all major muscle groups viz-legs, hips, back, abdomen, chest, shoulders, and arms.

  Or
- 1 hour and 15 minutes (75 minutes) of vigorous-intensity aerobic activity i.e., jogging or running every week **&**
- muscle-strengthening activities on 2 or more days a week that work all major muscle groups viz-legs, hips, back, abdomen, chest, shoulders, and arms.

  Or
- An equivalent mix of moderate- and vigorous-intensity aerobic activity **&**
- muscle-strengthening activities on 2 or more days a week that work all major muscle groups viz-legs, hips, back, abdomen, chest, shoulders, and arms [15,16].

Health Benefits of Physical Exercise: Features of adequate exercise and good effects of exercise are described with highly evolved manner in the Ayurvedic texts. In *Charaka Samhita* (one of the classical text of Ayurveda), Charaka has stated the features of correct exercise, as "Perspiration, enhanced respiration, lightness of the body, inhibition of the heart and such other organs of the body are indicative of the exercise being performed correctly." He mentioned the good effect of exercise, as "physical exercise brings about lightness, ability to work, stability, resistance to discomfort and alleviation of impurities (vitiated *doshas* & *malas*) [1]. It stimulates the power of gastro-intestinal biofire thus; it helps to promote the appetite and digestion of food particle along with tissue metabolism [17].

In physical exercise, there is tremendous variation in individual response to training; where most people will see a moderate increase in endurance from aerobic exercise, some individuals will as much as double their oxygen uptake, while others can never augment endurance [18]. This is idea is quite evident to the

Genomic theory of Ayurveda in which *Acharyas* clearly stated that every individual is differ as per his body constitutions. Hence, their dietary pattern, lifestyle, physical exercise, sleep pattern, disease pattern and line of management are also differing and individuals required specificity on the same. However, muscle hypertrophy from resistance training is primarily determined by diet and testosterone [19]. This genetic variation in improvement from training is one of the key physiological differences between elite athletes and the larger population [20].

Physical exercise is an important tool for maintaining physical fitness and can contribute positively to maintaining a healthy weight, building and maintaining healthy bone density, muscle strength, and joint mobility, promoting physiological well-being, reducing surgical risks, and strengthening the immune system. Recent researches supported that benefits of exercise are mediated through the role of skeletal muscle as an endocrine organ. In majority of the cases during physical exercise, contracting muscles release multiple substances known as myokines , which promote the growth of new tissue, tissue repair, and multiple anti-inflammatory functions, which in turn reduce the risk of developing various inflammatory diseases [21].

Physical exercise reduces levels of cortisol, which causes many physical and mental health problems [22,23]. Conversely, exercise increases levels of saliva nitrite, which may be converted to the nitric oxide, thereby, increasing intensity and training load. Saliva testing for nitric oxide serves as a marker for training status. Endurance exercise before meals lowers blood glucose more than the same exercise after meals. According to the World Health Organization, lack of physical activity contributes to approximately 17% of heart disease and diabetes, 12% of falls in the elderly, and 10% of breast cancer and colon cancer [24,25]. There is evidence that vigorous exercise induces a greater degree of physiological cardiac hypertrophy than moderate exercise, but it is unknown whether this has any effects on overall morbidity and/or mortality [26]. Both aerobic and anaerobic exercise increases the mechanical efficiency of the heart by increasing cardiac volume (aerobic exercise), or myocardial thickness (strength training).

Impact of Physical Exercise on Different Systems

Cardiovascular System: Ayurveda believes that physical inactivity play significant role to the genesis of *Hridaroga* (cardio-disorders). The beneficial effect of exercise on the cardiovascular system is well documented in conventional cardiology. There is a direct relation between physical inactivity and cardiovascular mortality and physical inactivity is an independent risk factor for the development of coronary artery disease. There is a dose-response relation between the amount of exercise performed from approximately 700 to 2000 kcal of energy expenditure per week & all-cause mortality and cardiovascular disease mortality in middle-aged and elderly populations [27].

Immune System & Inflammation: A large number of studies on exercise and the immune system but there is little direct evidence on its connection to illness. Immune cell functions are impaired following acute sessions of prolonged, high-intensity exercise, and some studies have found that athletes are at a higher risk for infections. The immune systems of athletes and non-athletes are generally similar. Athletes may have slightly elevated natural killer cell count and cytolytic action, but these are unlikely to be clinically significant.

Vitamin C supplementation has been associated with lower incidence of upper respiratory tract infections in marathon runners. Biomarkers of inflammation such as C-reactive protein, which are associated with chronic diseases, are reduced in active individuals relative to sedentary individuals, and the positive effects of exercise may be due to its anti-inflammatory effects. In individuals with heart disease, exercise interventions lower blood levels of fibrinogen and C-reactive protein, an important cardiovascular risk marker. The depression in the immune system following acute bouts of exercise may be one of the mechanisms for this anti-inflammatory effect [28,29].

Cancer & Cancer Cachexia: Evidences from 27 observational studies reveal that physical activity is associated with reduced all-cause of breast cancer–specific and colon cancer–specific mortality". Physical exercise is becoming a widely accepted non-pharmacological intervention for the prevention and attenuation of cancer cachexia. Cachexia is a multiorganic syndrome associated with cancer, characterized by inflammation, body weight loss (at least 5%) and muscle and adipose tissue wasting. The

exercise-induced transcription coactivator peroxisome proliferator-activated receptor-γ coactivator 1α (PGC1α), which suppresses FOXO and NF-κB dependent transcription during atrophy induced by fasting or denervation, may be a key intermediate responsible for the beneficial antiatrophic effects of physical exercise on cancer cachexia [30,31,32,33,34].

Epigenetic Effects: Physical exercise was correlated with a lower methylation frequency of two tumor suppressor genes, CACNA2D3 and L3MBTL. Hypermethylation of CACNA2D3 is associated with gastric cancer, while hypermethylation of L3MBTL is associated with breast cancer, brain tumors and hematological malignancies. According to the study, individuals who were more physically fit and who exercised more minutes per week had lower levels of DNA methylation. Those who increased their minutes of physical activity over 12 months experienced decreases in DNA methylation" [35,36,37,38].

Brain Function: Physical activity has been shown to be neuroprotective in many neurodegenerative and neuromuscular diseases. Evidence suggests that it reduces the risk of developing dementia. In addition, a 2008 review of cognitive enrichment therapies concluded, 'physical activity, and aerobic exercise in particular, enhances older adults' cognitive function' [39].

In mice, exercise improves cognitive functioning via improvement of spatial learning, and enhancement of synaptic plasticity and neuogenesis.http://en.wikipedia.org/wiki/Physical_exercise - cite_note-45 Furthermore, evidence suggests that frequent exercise may reverse alcohol-induced brain damage. There are several possibilities for why exercise is beneficial for the brain. Some examples are given below:

- increasing the blood and oxygen flow to the brain;
- Increasing growth factors that help neurogenesis and promote synaptic plasticity- possibly by improving short and long-term memory.
- Increasing neuro-chemicals in the brain that help in cognition, such as dopamine, glutamate, nor-epinephrine, and serotonin.

Physical activity is thought to have other beneficial effects related to cognition as it increases levels of nerve growth factors, which support the survival and growth of a number of neuronal cells [40,41,42,43].

Inducing Sleep: Charaka has proclaimed when the mind including the sensory and motor organs are exhausted by activity and they dissociate themselves from their objects, then the individual go in sleep. The sensory and motor systems are not active because of the inaction of individuals. This ancient idea is quite interesting and comparable to the latest development in the field of sleep biochemistry. A recent study reveals that exercise is the most recommended alternative as sleeping pills for resolving insomnia. Sleeping pills are more costly than to make time for a daily routine of staying fit, and may have dangerous side effects at the end in the body systems. Exercise can be a healthy, safe and inexpensive way to achieve more and better sleep [1,5,7].

In Depression: Physical exercise, particularly aerobic exercise, has pronounced long-term antidepressant effects and can produce euphoria in the short-term. Numerous systematic reviews suggest that regular aerobic exercise at sufficient intensity and duration; has comparable antidepressant efficacy to the standard pharmaceutical antidepressants. Recent medical evidences support the use of aerobic exercise as a treatment for depression. Exercise-induced antidepressant affects occurs due to increased neurotrophic factor signaling, particularly brain derived neurotrophic factors. Continuous exercise can produce short-term euphoria, through the increased biosynthesis of at least three euphoriant neurochemicals such as anandamide, ß-endorphine, and phenethylamine [44,45,46,47,48].

Physical Exercise and Nutrition: Proper nutrition is as important to health as exercise. In mathematical term, we can say that physical exercise and nutrition are directly proportional to each other. It means balanced nutrition provide sufficient energy and micronutrients to the exercising one, who are engaged in physical exercise. When exercising, it becomes even more important to have a good diet to ensure that the body has the correct ratio of macronutrients while providing ample micronutrients, in order to aid the body with the recovery process following strenuous exercise [49].

That is why Acharya Charaka provide it first place in trayopastmbhas i.e *Ahara* (nourishment), *Nidra* (sleep) and *Bramhacharya* (safe and protected coitus), which are the

subsidiary pillars to support the body throughout the lifespan, by providing the strength, complexion and growth. They are considered as subsidiary or secondary as the principal pillars of life i.e. three *Doṣhas* (*vata, pitta & kapha*). However, their importance in the normal functioning of the body cannot be over looked. Among these *Ahara* is mainly concerned with physical factors. Hence, one should apply rational thought as well as scientific knowledge to design one's own lifestyle. The *Ahara* is mainly concerned with the energy production and maintenance of living tissues to entire life [1,17].

Impact of Excessive Physical Exercise: In *Ayurvedic* text, Charaka has mentioned the features of excessive exercise such as exertion, exhaustion, consumption, thirst, bleeding from different parts of the body, dyspnoea, cough, fever and vomiting. Beside this, he also aware about the contra-indication of exercise in the persons who are emaciated due to excessive sexual activity, weight lifting and by travelling on foot and for those who are in grip of anger, grief, fear, exhaustion, and for the children, for the old person and for persons having *Vatika* constitution and profession of speaking too much. One should not do exercise while he is hungry and thirsty. This ancient idea is comparable to the latest development in this field [1,5,17].

Excessive physical exercise may create much harm to the humankind. Without proper rest, the chance of stroke or other circulatory problems increases, and muscle tissue may develop slowly. Inappropriate exercise can do more harm than good, with the definition of 'inappropriate' varying according to the individual [50, 51]. In extreme instances, over-exercising induces serious performance loss. Unaccustomed overexertion of muscles leads to rhabdomyolysis most often seen in new army recruits [52].

Stopping excessive exercise suddenly may create a change in mood. Feelings of depression & agitation can occur when withdrawal from the natural endorphins produced by exercise occurs. Exercise should be controlled by each body's inherent limitations. While one set of joints & muscles may have the tolerance to withstand multiple marathons, another body may be damaged by 20 minutes of light jogging. Too much exercise may cause amenorrhea in woman [50].

Conclusion: We finally conclude that the knowledge of physical exercise (*vyayama*) available in Ayurvedic lexicons with highly evolved manner, which is comparable to the latest development in this field. Living, working, walking and playing in the new millennium will provide numerous challenges and opportunities to the humankind. It will be necessary to develop and adopt newer strategies, methods, procedures and health related programs to fulfill the emerging needs of healthcare sector. In many respects, ancient and current perspectives of health and physical exercise will have to be re-thought and perhaps reinvented for the betterment of humanity.

Conflicts of Interest: None

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