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Sports science in Ayurveda

Dr. Dharmik Vasani^{1*}, Prof. Hitesh Vyas², Dr. Sunny Patil³, Dr. Preetpal Singh⁴, Dr. Ashvinee Vasava⁵

^{1,3,4,5} Ph.D. Scholar, Department of Basic Principles, ITRA, Jamnagar

² Professor & Dean, Department of Basic Principles, ITRA, Jamnagar

Abstract: Introduction: Sports science is a discipline that studies how the healthy human body works during exercise, and how sport and physical activity promote health and performance from cellular to whole body perspectives. The study of sports science traditionally incorporates areas of physiology (exercise physiology), psychology (sport psychology), anatomy, biomechanics, biochemistry, and biokinetics. All these branches of sports science are also explain in classical text of Ayurveda in different word. **Methodology:** A thorough search was done in *Charaka Samhitha*, *Sushruta Samhita*, *Astanga Hrudaya* and the available commentary on it and Article related to the study were analyzed and used for the study. **Observation:** Sports anatomy in Ayurveda is understood with the help of concept of *Mamsa*, *Asthi*, *Majja Dhatu*, Physiology of exercise is with the concept of *Vyayama*, Sports Biomechanics & Kinesiology is with the Concept of Vata Dosha, and sport psychology is with the Concept of Satva, Satvasara etc. **Discussion:** According to Ayurveda disease and health of individual has been classified into mainly two parts i.e., *Sharira* and *Manasa*. Sports medicine or sciences also can be categorized into same way. Anatomy, physiology (exercise physiology), biomechanics, biochemistry, and biokinetics areas of sports sciences come under *Sharira Bhava* of Ayurveda. Whereas psychology (sport psychology) comes under *Manasa Bhava* of ayurveda. **Conclusion:** Sports science in Ayurveda is better understood with the help of Concept of *Vata Dosha*, *Mamsa*, *Asthi* and *Majja Dhatu*, *Dhatu Sharata*, *Satvabala*, *Vyayama* and concept of *Bala*.

Key words: Sports Science, Sports Anatomy, Sports psychology, *Vata*, *Satva*.

Corresponding Author:

Dr. Dharmik Vasani,

Ph.D. Scholar, Dept. of basic Principles,

ITRA, Jamnagar,

Email: -dharmikvasani46@gmail.com, Contact no. -7984216763

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Introduction:

Sports science is a discipline that studies how the healthy human body works during exercise, and how sport and physical activity promote health and performance from cellular to whole body perspectives. The study of sports science traditionally incorporates areas of physiology (exercise physiology), psychology (sport psychology), anatomy, biomechanics, biochemistry, and bio kinetics.^[1] Sports offer both competition and a path to fitness. Accordingly, sports science has grown beyond the exclusive application of science toward improving competitive performance to applications that improve the quality of life and health.^[2] Basic knowledge regarding sports science is essential for players who are involved in competition or daily sports activity. Otherwise they may harm to their body or loss in the competition. Regarding this Leonardo Da Vinci says that who are enamored of practice without science are like a pilot who goes into a ship without rudder and compass and never has any certainty of where he is going.^[3] Ayurveda is the traditional medical system of India that is primarily a health care system aimed at prevention and cure of illness. Though it is a medical system, it has its own contribution in various other fields as

well - such as agriculture as in *Vrikshayurveda* and veterinary science as in *Gajayurveda*. This paper aims at exploring the scope of Ayurveda in making very significant contributions to the field of modern sports science.

Methodology:

Article published/available in electronic database search - PubMed, Google scholar, AYUSH Research portal, AYUSHDHARA, J-GATE were searched, unpublished dissertations and researches were also searched as part of hand search. A thorough search was done in *Charaka Samhitha*, *Sushruta Samhita*, *Astanga Hrudaya* and the available commentary on it and the contents and references were analyzed and used for the study.

Observations:**Sports Anatomy**

Anatomy is the concept that deals with the study of structure like muscles, bones and interior organs of the body. It is the kind of static research. Sports anatomy mainly deals with the study of musculoskeletal system of the body.^[4] The musculoskeletal system includes- Muscles, Bones, Joints, Tendons, Ligaments and different connective tissues for helps and binds tissues and organs together. They are accountable for

movements, balance and safety of the body. Observant of those components furthermore as structural identity the *Peshi, Asthi, Sandhi, Snayu* and *Kandara* can be concept of underneath musculoskeletal factors according to ayurveda descriptions. Apart from those systems any other anatomical additives specifically *Jala, Kurcha, Mamsarajju, Sevani, Sanghata* and *Simanta* additionally come below this system.^[5]

According to Ayurveda philosophy, *Dhatu Sarata* is one of the parameter to assess the strength of the person. *Dhatu Sarata* means qualitatively purest form of the *Dhatu*. Person having *Asthi Sarata* (purest *Asthu Dhatu*) and *Majjaa Sarata* (purest *Majjaa Dhatu*) can be a better sports person who can perform well in outdoor events. Characteristics of person with *Asthisara* has outstanding ankles (*Gulpha*), heels (*Parshni*), elbows (*Aratni*), knee (*Janu*), chin (*Chibuka*), collarbones (*Jatru*), head (*Shira*), flanks (*Parshva*) and teeth (*Danta*) such persons are extra enthusiastic very energetic enduring having robust and organization body in addition to longevity they are able to bearing ache and fatigue their body may be slender however strong and firm they're satisfactory appropriate for difficult bodily sports activities and war.^[6] Characteristics of *Majja*

Sara are with small body and having good endurance, strong bones and joints. They are oily in complexion and are very agile. They are endowed with good physical stamina, power, knowledge, and demand dignity and respect.^[7]

Exercise physiology

Exercise physiology is the physiology of physical exercise. It is one of the allied health professions, and involves the study of the acute responses and chronic adaptations to exercise. Understanding the effect of exercise involves studying specific changes in muscular, cardiovascular, and neurohumoral systems that lead to changes in functional capacity and strength due to endurance training or strength training.^[8] In Ayurveda, such suitable physical movement intended towards bringing stability and increase in strength is known as *Vyayama* (physical exercise).^[9] To understand the physiology of *Vyayama* according to Ayurveda knowledge regarding *Vata Dosha, Mamsa Dhatu*, concept of *Bala* are essential. *Vata Dosha* is responsible for each and every movement of body.^[10] Imbalance in *Vata Dosha* leads to deformity in body movements or exercise.

Although *Mamsa Dhatu* can be compared to muscular tissue in modern science, ayurvedic texts reveal that *Mamsa*

Dhatu has a much broader concept than muscular tissue; a person's well-built musculature indicates good and proper nourishment of the individual. According to ayurvedic concept, *Mamsa Dhatu* is responsible for the strength, stamina, and power of the body. Additionally, well-developed muscle the relevant *Dhatwagni*, namely the *Mamsadhatwagni*, forms *Mamsa Dhatu* by metabolizing *Rakta Dhatu*.^[11] Therefore, any anomaly or detour in this process results in illnesses focused on *Mamsa Dhatu* and undoubtedly affects upcoming *Dhatu*s in the chain. Emaciation and other types of muscle wasting illnesses are clearly seen in *Mamsa Dhatu* abnormality, which negatively impacts human health overall and lowers resistance to illness. Therefore, it is crucial for maintaining life and extending it. Concept of *Bala* also helps to understand the physiology of exercise. Individual exercise capacity depends upon its *Bala*. *Prakruta kapha, Udana Vata, Rakta, Mamsa Dhatu, Oja* etc. are termed as a *Bala* by different Acharya. According to Acharya Sushrut, excellence of *Rasa* to *Shura Dhatu* is responsible for good *Bala*. Acharya *Dalhana* clear it by saying there is a *Karya-Karana Bheda* means excellence of all *Dhatu* is a *Karana* and *Bala* is a its *Karya*.^[12]

Bala is majored by exercise capacity of individual.^[13]

Biomechanics & Kinesiology

Biomechanics is the study of the structure and function of biological systems by means of the methods of “mechanics.” – Which is the branch of physics involving analysis of the actions of forces. Within “mechanics” there are two sub-fields of study: (1) statics, which is the study of systems that are in a state of constant motion either at rest (with no motion) or moving with a constant velocity; and (2) dynamics, which is the study of systems in motion in which acceleration is present, which may involve kinematics (i.e., the study of the motion of bodies with respect to time, displacement, velocity, and speed of movement either in a straight line or in a rotary direction) and kinetics (the study of the forces associated with motion, including forces causing motion and forces resulting from motion).^[14] According to Ayurveda, static and dynamic biomechanics can be better understand with the concept of *Vata*. According to Acharya Charaka, *Vayu* or *Vata* is responsible for the normal working of the *Tantras* and the *Yantras* of the body^[15]. *Tantra*, in general, means a system such as nervous system, cardiovascular system, endocrine system etc.

Yantra denotes an organ as such, a viscus. An organ has its own functions to perform, at the same time it is a part of a system and has to work in unison with other parts of the system at a particular time in a particular situation. If *Vata* gets controlled by individual can attain static balance. Dynamic biomechanics is also a function of *Vata Dosha*. According to Acharya Charak unvitiated *Vata* is the *Pravartaka* of *Uccha Chestanam* means initiates upward movement and *Pravartaka Awacha Chestanam* means initiates downward movement.^[16] These two actions are equal and opposite to one another. *Vata* causes one type of action to take place in the body. After some time when that action is not needed it begins nullifying it by causing opposite action. For example, we need flexing of the arm, after that extension of the arms are to be done. Both flexion and extension or pronation and supination, abduction or adduction are all done by *Vata*. *Vata* is the initiated of these pro or opposite functions. Moving forward or backward, upward or downward, to the right or to the left, pulling or pushing are all the normal activities of *Vata*. According to Ayurveda, mainly five types of movement has been explained i.e. *Utkhepana*, *Avakshepana*, *Ankuchana* (motion causing shear stress), *Prasarana*

(motion causing tensile stress) and *Gamana* (linear motion). These body movement is nothing but kinesiology in sports science. What are termed as the motorial or locomotive functions of the body are produced, promoted, initiated, or prompted by *Vata*.

Biochemistry

Biochemistry for Sport and Exercise Metabolism will prove invaluable to students across a range of sport-related courses, who need to get to grips with how exercise mode, intensity, duration, training status and nutritional status can all affect the regulation of energy producing pathways and, more important, apply this understanding to develop training and nutrition programs to maximize athletic performance.^[17] Biochemistry is the application of chemistry to the study of biological processes at the cellular and molecular level.

Acharya Charaka also explained about Biochemistry for sports and exercise metabolism. Acharya Charaka says *Sthairyarthi Balavardhini* for physical exercise means exercise provides stability and firmness to the *Dhatu*, and this quality of *Dhatu* ultimate provides strength to the body. sports person gets lightness, capacity to work, firmness, tolerance of difficulties,

diminution of impurity, and stimulation of Agni (digestive fire/ metabolism).^[18] Transformation at cellular level take place by Agni. Nourishment of the body after exercise is also depend on *Prakruta Agni*. Acharya Charak says that *Vyayama* stimulates the *Agni* if it done with proper rules and regulation.

Sport psychology

Although many definitions of sport psychology have been suggested, there has been no comprehensive and internationally accepted definition of sport psychology. In its Position Stand # 1 (1995), the European Federation of Sport Psychology (FEPSAC) proposed that “sport psychology is concerned with the psychological foundations, processes, and consequences of the psychological regulation of sport-related activities of one or several persons acting as the subject(s) of the activity” This definition indicates that sport psychology attempts to improve athletic performance and help athletes to concentrate better, deal effectively with competitive stress, and to practice more efficiently. Moreover, sport psychology also attempts to understand the impact of long-term sport participation on development of personal resources of athletes in the setting of organized competitive sport. ^[19] In Sports, Mental

stability is a collection of values, attitudes, behaviors and emotions, which enable an athlete to persevere and overcome any obstacle, adversity or pressure experienced, and also helps to maintain concentration and motivation even when things are going well, to consistently produce high levels of performance and achieve the goals. ^[20] In Ayurveda, Mental Toughness can be better understood in the light of the concepts like *Satva*, *Satvabala*, *Pravara satvatha* etc. *Satva* is considered as the synonym of *Mana*, it has been used in various contexts by Acharyas denoting personality type, mental strength, and psycho somatic constitution etc. ^[21] *Pravara Satva* is considered as a best among three types of *Satva*. Person having a *Pravara Satva* can do good performance in sports. The description of ‘*Satva Sara Purusha*’ by Acarya Caraka goes well in accordance with the features of a mentally strong person. ^[22] In *Susrutha Samhita*, *Satwasara* persons are explained as having qualities like *Smruti*, *Bhakti*, *Prajna*, *Sourya*, *Suchitwa* and are always engaged in *Subha Karya*. ^[23] *Manasika Bala* is examined by - *Utshaha* (Enthusiasm).

Discussion:

Well detailed depiction regarding all above mentioned branches is available in Ayurvedic classics. Many times it is not seems

to be directly related with the sports science, but in terms of principles which can be applied in the sports science. Musculoskeletal components are observed in terms of *Peshi, Asthi, Sandhi, Snayu, Kandara* along with *Jala, Kurcha, Mamsarajju, Sevani, Sanghata* and *Simanta* by observing their composition, characteristics as well as functional aspect.^[5] Sarangadhara mentioned that *Snayu* are the structures that bind the muscles, bones etc. together which clearly indicate as ligaments and tendons of the body.^[24] *Kandara* is identical terminology for tendon in specific, while sometime it can also be understood as ligaments and intramuscular septum. Other relating musculoskeletal components like *Jala, kurcha, Mamsarajju, Sevani, Sanghata* and *Simanta* represent Retinaculum, Aponeurosis, rope shape muscles, Raphe and Sutures, and joints of the extremities respectively by considering from their morphological as well as physiological aspects. Exercise physiology is mainly described in the terms of *Vyayama Guna* and *Ativyayamajanya Hani*. It is very clearly mentioned that regular physical exercise has beneficial effects on metabolism, musculoskeletal system and even on immune system. Maharshi Charaka says that there is nothing like exercise for achieving stability, while

Maharshi Sushrut opines that it is the best remedy for reduction in obesity.^[25] Physical exercise is one bodily activity that enhances or maintains physical fitness, overall health and wellness. Sushrata and Vagbata called it *Suvibhaktata* and *Vibhakta Gatravvam* (well build body).^[26-27] Endurance to high amount of stress is indicated by Charaka as *Duhkha Sahishnuta* and by Vaghhata as *Karma Samarthyaa*.^[28-29] i.e. capacity to strain to maximum extent. During *Vyayama* a series of changes happens in body in which the first one is the development of *Ushna Guna*. The *Ushna* triggers the *Chala-Guna* of *Vyana Vayu*. It increases the heart beats and blood circulations to the muscles. The heart rate also increases up to 180 – 260 beats/min in moderate to severe exercise. It was controlled by increased temperature and vagal withdrawal reflex from proprioceptors in muscles. For continuing exercise body requires constant energy supply, for that *Kapha* present in the particular *Mamsa Dathu* will convert into *Urja* in the presence of *Rasa Dathvagni*. Depending on the *Chala guna* of muscle exercise is divided into dynamic and static exercises. According to Acharyas normal the *Gati* of *Vata* will be from *Shakha* to *Koshta*. During *Vyayama* the *Gati* of *Vata* reverses. That means in severe exercise the

systolic pressure increases and the diastolic pressure decreases due to less peripheral resistance. As the exercise continues the *Ushnaguna* increases and send signals to hypothalamus, which results in peripheral vasodilatation and sweating. *Sweda Pravarthi* will result in the dehydration and haemo concentration. During first stage of *Vyayama* body use the *kapha* in the *Mamsa*, then next stage it uses the most reachable one i.e. *kapha* of *Rasa* and *Raktha Dhatu* and finally use the *Kapha* of *Medas*. During the period of exercise *Vatapitta Dosha* will increase and *Kapha Dosha* decreases. The *Veerya* (stamina) and *Bala* (strength) of the body is provided by *Sukra Dhatu*. Other *Dhatu* like *Mamsa* and *Medas* give *Bala* and *Dridatha* (firmness), *Rasa* and *Rakta Dhatu* give *Poshana* (nourishment), *Majja* and *Asthi* give *Sneha* (lubrication) and *Stiratha* (stability).^[30] Though the direct references regarding sports psychology is not available in literature, but the elaborated description of mind with its subjects, functions are very important in this regard. Classification according to psychological status of persons (*Manas Prakruti*) is unique concept of Ayurveda, can be used in sports related problems. Relation of body and mind is very nicely mentioned in Charaka Samhita which

is very useful concept in this context. Sport science literature frequently suggests that both game intelligence and tactical creativity are important for successful athletes in different kinds of sports. According to Ayurveda disease and health of individual has been classified into mainly two part i.e. *Sharira* and *Manasa*.^[31] Sports medicine or sciences also can be categorized into same way. Anatomy, physiology (exercise physiology), biomechanics, biochemistry, and biokinetics areas of sports sciences come under *Sharira Bhava* of Ayurveda. Whereas psychology (sport psychology) comes under *Manasa Bhava* of Ayurveda.

Conclusion:-

Sports science in Ayurveda is better understood with the help of Concept of *Vata Dosha*, *Mamsa*, *Asthi* and *Majja Dhatu*, *Dhatu Sharata*, *Satvabala*, *Vyayama* and concept of *Bala*.

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