Physical fitness is of major concern today. Body workouts and other similar methods have come to provide best physical fitness. Each of these methods has its own background and antecedent. Knowing them would therefore, help us better understand its functioning and thereby enable us to tailor make the fitness module and strategies as per the needs of an individual.

Tracing the origin of these various sources not only provides cultural background, but also enables us to understand the mechanism. This goes a long way in customizing the fitness module. In this chapter, an attempt is made to understand the concept of physical exercise (Vyāyāma) and physical posture (āsanas) from the perspectives of ancient literary sources.

Physical exercise has been given great importance in ancient times, which can be seen from the number of citations from classic texts of Ayurveda. The primary objective of exercise was projected to be the overall health of body avoiding diseases. However, physical fitness has higher goals too, like support for deeper spiritual practices, for which āsanas from yoga has been introduced. Āsanas have been projected as a potential candidate to achieve not only physical fitness but also train the body for undertaking spiritual practices. Hence, there are some extra elements like awareness, regulation of prana, etc., which come into picture. The description and implication of these are presented in this chapter. Based on this, a theoretical model has also been attempted.
2.1 AIM

To understand the concept of *vyāyāma*, and *āsanas* from ancient scriptures.

2.2 OBJECTIVES

1) To understand the various aspects of *vyāyāma* according to ancient scriptures.

2) To understand the various aspects of *āsana* according to ancient scriptures.

3) To understand how *vyāyāma* progresses into *āsana* with its unique features.

2.3 METHODOLOGY

Relevant *slokas* selected from *Shastrani* were used (Shastrani, 2004). Also we referred to Multilingual E-*Samhita* with search option prepared by CCRAS, Department of AYUSH, Ministry of Health and Family Welfare, Government of India. There were 116 occurrences of the word *vyāyāma* in *Charaka Samhita*, and 68 occurrences of the word *vyāyāma* in *Sushruta Samhita*. A few other texts like *Astanga Hridaya*, etc., also led to more citations. Based on the scrutiny of these *slokas*, a model of evolution of *vyāyāma* to *āsana* has been attempted.

2.4 DEVELOPMENT OF THEORETICAL MODEL

*Vyāyāma* is the term denoted to physical exercise, and *āsana* is a specific physical posture which has additional unique features like awareness, relaxation, longer postural stability,
and effortless sense of expansion. In a way, we can consider that āsana is a metamorphosed form of Vyāyāma.

Like a caterpillar, Vyāyāma evolves into āsana like a butterfly.

Vyāyāma has been defined and described in various Ayurveda texts. Vyāyāma has been defined as a means to maintain health and is incorporated in daily routine. Detailed procedure has been enumerated along with various do’s and don’ts. Seasonal components and other general guidelines are also given. Āsanas on the other hand has been presented as a foundational step towards higher practice of spiritual disciplines. Normal health comes as a natural ingredient of this package. Essentially āsanas, have all the features of Vyāyāma, and also some key distinguishing features like awareness while practice, careful regulation of prāna through breathing and directing attention of mind. There is also a huge difference in physiological and psychological dimensions. Importance of cumulative effect of regular practice is highly emphasized in āsanas. The progress is also measured on the basis of enduring stability of not only the body but also of the mind.
Higher Dimensions of Yoga

- Continuous practice
- Stimulation & Relaxation
- Steadiness, Easiness
- Awareness

Vyāyāma
- Has Seasonal restriction
- Physical level
- Rest during exercise is not possible
- No awareness element

Āsana

Fig. 2.1: Model of Evolution of Vyāyāma to Āsanas
Based on the above discussed points, a schematic diagram has been presented to illustrate these concepts graphically. Key distinguishing features have been presented. However, the features of āsanas being supplementary in nature, we have preferred to view āsanas as a metamorphosed state of Vyāyāma, with all the key ingredients intact, with certain add-on key features like expansive awareness and deep psychological calmness.

2.5 TEXTWISE PRESENTATION OF MODEL FROM ANCIENT SCRIPTURES

Various scriptures were scrutinized under the following headings, like definition of Vyāyāma,, benefits of Vyāyāma,, limitation of Vyāyāma, time for Vyāyāma, do’s and don’ts, contraindications etc. Vyāyāma, (exercise) has been extensively referenced in ayurveda and other traditional texts. In the following section, we have attempted to present the concept of Vyāyāma, and very briefly about the āsana, and attempted to highlight how Vyāyāma, can evolve as āsana with addition of certain vital components like expansion and relaxation.
CONCEPT OF VYĀYĀMA

ASTĀNGA HṚDAYAMĪ

Benefits of Vyāyāma,

व्यायाम विभृत्तपन्न्यत्वं व्यायामादुपनायते ॥ १० ॥

Lightness (of the body), ability to do (hard) work, keen digestion, depletion of (excess) gas, stable and distinct physique accrue from Vyāyāma, (physical exercise). Persons suffering from diseases of vāta and pitta; children, the aged and those having indigestion should avoid it. (10)

Limitation of Vyāyāma:

Persons who are strong and who indulge in fatty foods (daily); in cold seasons and spring (season) should do it (exercise) to half of their strength (capacity) only; while others (and in other seasons) should do it mildly. (11)
Note: Half the capacity of the person is understood by appearance of perspiration on his forehead, nose, axilla, joints of the limbs and feeling of dryness of the mouth.

ते कृत्वा नुसुखं देहं मद्यिक्ष समन्ततः ||१२ ||

tāṁ kṛtvā nusukhaṁ dehaṁ mardayecca samantataḥ ||12||

After doing it (exercises) all the parts of the body should be massaged comfortably. (12)

Limitation of vyāyāma:

तृणा क्षयः प्रतमको रक्तपितं श्रमः क्रमः ||

अतिव्यायामं: कासो ज्वरचर्चिण्यो जायते ||१३ ||

trṣṇā kṣayaṁ pratamako raktapittaṁ śramaṁ kmaḥ ||
ativyāyāmataṁ kaso jvarachardīśca jāyate ||13||

Thirst, emaciation, severe dyspnoea (difficult or excess breathing), bleeding diseases, exhaustion, feeling of debility (even without any work), cough, fever and vomiting are caused by excess of exercise. (13)

व्यायामजागराध्यस्तीहस्तविधिसाहसम ||

गजं सिंहं इवाकर्षनं भजमृतिविनिष्टिः ||१४ ||

vyāyāmājāgarādhvasriḥsahsvātyādi sahasam ||
gajāṁ siṁha ivākarṣan bhajannatīvināśati ||14||

Those who indulge daily in too much of physical exercise, keeping awake at night (loss of sleep), walking long distances, sexual intercourse, too much of laughing, speaking and such other strenuous activities perish, just as a lion, after vanquishing an elephant. (14)
**Note:** The lion though vanquishes and kills the elephant, dies soon afterwards due to severe strain and consequent exhaustion. This simile is to impress upon avoiding excess of physical work.

**BHĀVAPRAKASA PURVAKHANDE OF BHAVAMISRA**

Benefits of *vyāyama*

वाघवं कर्मसामार्थ्यं विभक्तचं गात्रतं ।

dोषक्षयोऽश्रव्युक्तिः व्यायामादुपज्यते ॥४७ ॥

लाघवानि कर्मसामर्थ्यानि विभक्तां गात्रताः ।

doषक्षयोऽग्निवृद्धिः स्वायामादुपज्यते ॥४७॥

Lightness of the body, capacity to work, well shaped and thick body build, mitigation of dosas, and increase of digestive capacity, accrue from exercise.

**Vyāyamahṛdaya-vyāhīnīstāt kāraṇaḥ ॥**

विरुद्ध वा विदर्घ वा भूष मीण विष्णु विपक्षते ॥४८ ॥

vyāyāmadrṛdhagātrasya vyādhirnāsti kadācana ।

virudghānā vā vidagdhaḥ vā bhuktaḥ sīghrahān vipacyate ॥४८॥

The person who does exercise daily and so possesses a strong body does not suffer from diseases any time; foods which are incompatable or improperly cooked though consumed get digested quickly.

भवन्ति शीघ्रं नैतस्य देहे शिथिलतादेहः ॥
his body does not develop weakness or looseness (of joints) etc quickly; nor old age
invades him quickly

there is no other thing equal to it (exercise) in removing obesity (stoutness), it draws the
qualities of a thin built man who is attracted by moderate eating habits.

it is especially beneficial during vasanta (spring) and sita (winter), even in other seasons it
should be done to half the strength of the person. (47-51)

Symptoms of excess vyāyāma

hṛdayastho yadā vāyuvaṅkṛte śīṣṭe praparthe | ५२ || ।

mukhāṃ āśōṣṭaṃ labhate tadā balarṣeṣvya ṣūkhṣmaḥ | ५२ || ।

hṛdayastho yadā vāyuvaṅkṛtām śīghraṁ prapadyate |
The symptoms of half the strength (of the person) are: vāyu (air) present in hṛdaya (chest) moves up to the mouth quickly and mouth becomes dry,

किं वा ठुलाये नासायां गात्रसनिप्पत्तिवरुणु कक्षी: ।

यदा सन्धायते स्वेदो बलाधृ तु तदादिशेतु ॥५३ ॥

kiṁ vā lālāte nāsāyāṁ gātrasandhiṣu kaksyoḥ ।
yadā saṁjāyate svedo balādaṁ tu tadādiṣet ॥५३॥
or when sweat appears (in more quantity) on the forehead, nose, joints, axillae etc., these are the symptoms of half the strength (of the person). (52-53)

Contraindications for vyāyāma

भूक्तवान्नक्तसम्भोगः कासी श्वासी कृश क्षयी ।

रक्तपित्तो क्षति शोषणि न तं कृयात्कदाचन कर्तवे ॥५४ ॥

bhuktavānkkrtasambhogah kāśī ścāśī kṛśa kṣyē ।
raktapitto kṣatī śoṣa na taṁ kṛtyātkadācana ॥५४॥

Person who has taken food just then, who has indulged in consumption, bleeding diseases, injury to lungs or tuberculosis should never do exercise. (54)

Bad effects of excess vyāyāma

अतिव्यायामतः कासी ज्वरज्वरस्तिं: श्रमः क्रमः ।

तृणाशक्ष्यः प्रतमको रक्तपित्तं च जायते ॥५५ ॥

भूक्तवान्नक्तसम्भोगः कासी श्वासी कृश क्षयी ।

रक्तपित्तो क्षति शोषणि न तं कृयात्कदाचन कर्तवे ॥५४ ॥

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तृणाशक्ष्यः प्रतमको रक्तपित्तं च जायते ॥५५ ॥
Excess of exercise, gives rise to cough, fever, vomiting, debility, fatigue, thirst consumption, bronchial asthma and bleeding diseases. (55)

SUSRUTA SAMITA

शारीरारासजनन कर्म व्यायासजितम् ।
तत् कुत्ता तु सुख देह बिमुद्दासीयात् समन्ततः ॥ ३८ ॥
śārīrāyāṣajanaṁ karma vyāyāsasajjatam |
tat kṛtvā tu sukham dehaṁ vimūḍdāṁ śamantataḥ ॥ ३८ ॥

शारीरोपच्छः कान्तिरागाराणं सुभिन्नता ।
दीर्घकालिनात्तथस्थितस्तं लघवं मूत्रा ॥ ३९ ॥
śārīropacyaḥ kāntirāgrānāṁ suvibhaktatā |
dīptagnitvabhamāṭhāniṁ sthiratvāṁ lāghavāṁ mūtā ॥ ३९ ॥

श्रमक्रमपिपोष्णाशीतादीनां सहिष्णुता ।
श्रारोग्यं चापि परम म्यायामदुपजयते ॥ ४० ॥
śramakramapiśosṇāśitādānāṁ sahiṣṇutā |
śrārogyaṁ ca paramaṁ vyāyāmadupajayate ॥ ४० ॥

न चारित्त सहरं तेन किर्दित श्वेत्याकर्षणाम् ।
न च व्यायामिनं मत्यार्द्धप्यस्य बलात् ॥ ४१ ॥
na cāsti sahāsāṁ tena kiścit śatālītyāpakaraṇāṁ |
na ca vyāyāmināṁ martyamardayantyayo balāt ॥ ४१ ॥

न चैनं सहसांसक्मण्यं जरा समधिरेहति ।
स्थिरीभवति मांसं च व्यायामाभिरतस्वः च ॥ ४२ ॥

na caināṁ sahasā’kramya jārā samadhirohati |
sthiaribhavāti māṁsaṁ ca vyāyāmābhiraśasya ca ॥ ४२ ॥

व्यायामास्विचन्द्रात्मकार्यः पदृश्यामुद्वितियः ॥ ४२ ॥

व्यायमो नोपपर्जन्ति सिङ्ग कुन्दमृगम् ॥ ४३ ॥

vyāyāmaśvinnagātrasāya padūbhāmudvartitasya ca |
vādhyayo nopaśarpante siham kṣudramṛgā ivā ॥ ४३ ॥

व्योरुपणुण्डिनिमपि कुर्वत सुदर्शनम् ॥

व्यायामं कुर्वतो निस्यं विरुद्दभमपि भोजनम् ॥ ४४ ॥

vàyorupagunāirhīnamapi kuryāt sudarśanam |
vāyāmanāṁ kuryāt nisyāṁ viruddhamapi bhodīnam ॥ ४४ ॥

विदग्धमविदर्प्यं वा निर्दौर्यं परिप्रच्छते ॥

व्यायामो हि सदापत्यो बलिनां स्तिथामोजिनाम् ॥ ४५ ॥

vidagdhamavidagdham vā nirdoṣāṁ piripacyate |
vāyāmo hi sādā payyo balināṁ snidhamojinām ॥ ४५ ॥

स च शीते वसन्ते च तेवां पृथ्यतमः स्मृतः ॥

सवेष्टुरुष्वहरणस्य पुर्विरास्मनीतिपितमिः ॥ ४६ ॥

sa ca śīte vasante ca teśāṁ pathyātamaṁ smṛtaḥ |
sa vaśvagvāratvaharāham pugmirāsmahitāsimiḥ ॥ ४६ ॥

बल्स्याधैन कर्त्त्वयो व्यायामो हन्स्योपन्यथा ॥

ढंदि स्थानस्थितो वायुर्मदा वक्रं प्रपथते ॥ ४७ ॥
Definition of Vyāyāma:

The work involving exertion of the body is known as ‘vyāyāma’ (physical exercise). After doing it one should press the body gently all over.

Benefit of Vyāyāma:

Physical exercise causes physical development, luster, compactness of body parts, stimulation of digestive power, absence of idleness, firmness, lightness, cleanliness, tolerance to fatigue, exhaustion, thirst, heat, cold etc. and provides optimum immunity.
There is no anti-obesity measure equal to physical exercise; one who performs physical exercise regularly can’t be overcome by enemies, he can’t be attacked and subdued suddenly by senility and his musculature becomes firm.

Diseases do not move towards him, like trifling animals to lion, who sweats with exercise followed by pressing with feet. It makes a person charming even if devoid of (youthful) age, look and qualities.

Even incompatible food, cooked or uncooked, is digested without any difficulty in person performing exercise daily.

Physical exercise is always wholesome for those are strong and take unctuous food. That too has the most salutary effect in winter and spring.

**Time for Vyāyāma:**

In all seasons daily exercise should be performed by persons desiring their well-being by ‘balardha’ (half of strength) otherwise it harms.

When (prana) vayu situated in heart comes out to mouth while performing exercise- it is the sign of the half of strength.

**Do’s and Don’ts:**

Physical exercise should be performed after considering age, physique, place, time and diet; otherwise one is afflicted with severe disorder.
**Limitation of Vyāyāma:**

Wasting, thirst, anorexia, vomiting, intrinsic hemorrhage, giddiness, exhaustion, cough, consumption, fever and dyspnoea – these are caused by excessive exercise.

Physical exercise should be avoided by one suffering from intrinsic hemorrhage, emaciation, consumption, dyspnoea, cough and wound, after taking food, wasted due to sex and afflicted with thirsty and giddiness.

**CARAKA SAMHITA**

**Definition of Exercises:**

शरीरचेत् या चेत्ताः स्थैर्यचेत्ताः बलवापिनी।
देहव्यायामसंस्थाताः मानवत्ता तं समाचरेत।॥ ३१॥

śarīraceṣṭāṇaḥ ca sthāryārthā balavārthā|
dehavyāyāmasaṅkhyātā mātrayā tāṁ samācāret∥31∥

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. (31)

**Good effects of exercise:**

लाघवं कर्मसामाध्यम् स्थैर्यम् दुःखसहिष्णुता।
दोषशोधिनिज्ञवृद्धि व्यायामादुपजायते॥ ३२॥

lāghavam karmasāmārthya sthāryam duḥkhasahihṣṣṇutā |
doṣākṣayaṁ gnivṛddhiśca vyāyāmadūpajāyate∥32∥

Physical exercise brings about lightness, ability to work, stability, resistance to discomfort and alleviation of doṣas (specially kapha). It stimulates the power of digestion. (32)

**Bad effects of excessive exercise:**
Physical exercise in excess causes exertion, exhaustion, consumption, thirst, bleeding from different parts of the body (raktapitta), pratamaka (a type of dyspnoea), cough, fever and vomiting. (33)

Features of correct exercises:

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.

Excess of following behaviors is bad:

One should not practice, exercise, laughing, speaking, travelling on foot, sexual activities and night walking in excess, even if one is accustomed to these. (34)
One who indulges in these and such other activities in excess suddenly perishes like a lion trying to drag an (huge) elephant. (35)

**Contra Indication of Exercise:**

Exercise is contra-indicated for 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 persons and for persons having vāta constitution and profession of speaking too much. One should not do exercise while he is hungry and thirsty also. (35 : 1-2)
The regular performance of *Vyāyama* or exercise causes lightness of the body, improves level of performance, reduces the body fat, promotes properly differentiated and firm physique, pacifies increased *doṣas* and promotes *jātharāgni*. No disease occurs to those
persons whose body is made firm with exercise. “To those who resort to daily exercise, even foods that are mixed of opposite properties (viruddha) or which are not digested properly are digested quickly. Body is not turned flaccid easily. Ageing and grayness do not attack with speed. There is no other remedy equal to this to reduce obesity of the body. The vyāyāma is always good for people who regularly use ‘singdha’ fat food and who are strong. This is more useful in vasanta and seta kala”. (45-48)

**Vyāyāma in other Ritus (seasons):**

**Vasanté Śītásamaye Suvarnasya Śāhita Mātā: || 49 ||**

basante śītasamaye suṭarāṁ sa hito mataḥ
anyādā’pi ca kārttavyo balārdhena yathā balam || 49 ||

**Hṛdayasthō Yādā Vāyuvaraktrañ Śīghraṁ Prapadyate || 50 ||**

hrdayastho yadā vāyuvaraktrañ śīghraṁ prapadyate
mukhaṁ ca śōṣaṁ labhate tad balārdhasya lakṣaṇam || 50 ||

Except in vasanta (spring) and śīta (cold) seasons, in all other rtu or seasons, exercise should be undertaken to one’s half strength i.e. ‘balardha’ which can be felt, when one’s mouth starts becoming dry (mukha śoṣa) because of vāta aggravation. (49-50)

**Kim Vā Lalāte Nāsāyaṁ Gaṇatrasniḥṣa Kukṣyaḥ: || 51 ||**

kim vā lalāte nāsāyaṁ gātrasandhiṣu kakṣayoh |
Further the ‘Balardha’ condition can be judged by ‘the appearance of perspiration or sweating over lalata (forehead) nasika (nose), body joint region, and kaksi regions armpit.

(51)

**Contra indications for vyāyāma (exercise):**

- bhukta-vānkrta-sambhogaḥ kāσī ṣvāśī kṛśa kṣāyī ।
- raktapīṭhi kṣatia ṣoṣī na taṅ kṛṣyātkadacana ॥54॥

vyāyāma should not be undertaken after having meals, sexual intercourse, kasa swasa rogi (asthma patient), weak persons, Ksaya (severely debilitated or tuberculosis patient), raktapitta (bleeding conditions), ksata or injured, and sosa or dehydrated patients. These class of people should not indulge in exercise (52)

**Complications of excessive exercise:**

- ativāyāmataḥ kāso jvaraśchardirbhramaḥ klamaḥ ।
- trṣṇākṣayaḥ pratamako raktapīttaiḥ ca jāyate ॥53॥

The complications of excessive vyāyāma or exercise are kasa, jwara (fever), chardi (vomiting), bhrama (vertigo), (klama the psychological debility), trsna (thirst), ksaya (wasting), swasa (asthma), raktapitta (bleeding) disorders. Therefore one should not
indulge in severe exercise of any form. One should always remember the age old saying –

_athi sarvatr varjayetey._ (53)
Discussion

Concept of vyāyāma was elucidated above through various textual references. The main points to highlight are, that vyāyāma is prescribed for maintaining good physical health and thereby leading a harmonious life. How vyāyāma can help for various physical problems, how it can be incorporated in daily routine, its benefits, and limitations are discussed. However, vyāyāma has not been presented as a basis for higher spiritual practice. So, the focus of vyāyāma is mainly physical health, and spiritual benefit, if at all present is understood as a secondary outcome. This one difference has far reaching consequences in differentiating the two labels, vyāyāma and āsana. The key distinctive features are presented in the following section.

CONCEPT OF ĀSANA

Āsana is considered as one of the limbs of astāṅga yoga of Patanjali. In fact, after yama and niyama, āsana comes showing that it is of foundational importance. The overall understanding here is that, our existence is not only limited to this physical body, but it is much beyond that including subtle and causal bodies. The ultimate goal is to make this body a fit instrument to undertake higher spiritual practices and thereby attain the final goal of the ultimate union. In the following section, a few representative verses from major texts of yoga has been presented, highlighting the most important features of āsana.
Patañjali Yoga Sūtras

स्थिर-सुखमासनम्।

Sthira-sukhamĀsanam

(P.Y.S. 19)

Āsana is practiced firmly with ease.

This means that the student should try to get absolutely disciplined in various Āsanas, so that he can sit motionless and relaxed for various advanced disciplines and practices in yoga.

प्रयत्नशैल्यान्त्र-समापत्तिभ्याम्

Prayatna-śaithilyānanta-samāpattibhyām

(P.Y.S.V-20)

An Āsana is performed through the process of exertion and relaxation until its completion.

ततो द्वन्द्वानन्दिभागः।

Tato dvandvānabhīghataḥ

(P.Y.S. V-21)

By practicing Āsana properly, one is free from impact of pairs of opposites.

Haṭha Yoga Pradīpikā

अथासःने हेढे योगी वशी हितमिताशनः।

गुरूपदिष्टमाणेन प्राणायामात्मस्मत्सेतु ॥ १ ॥

athāsane dṛđhe yogī vaśi hitamitiśādanaḥ

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Being established in Āsana and having control (of the body) and taking a balanced diet one can start prānāyāma according to the instructions of the Guru.

Description of meditative āsana in Bhagavadgītā

Holding the trunk, head and neck steady, remaining firm and fixing the gaze on the tip of the nose without looking in other direction.

Discussion:

The key feature highlighted here is the experience of expansive nature and the feeling of perfect ease and comfort in the final posture of āsanas. Mastering this one should practice other limbs of yoga like prānāyāma etc., and thereby prepare oneself for higher practices of meditation and higher levels of experience.

EVOLUTION OF VYĀYĀMA TO ĀSANA

As mentioned in the model earlier, vyāyāma can be considered as primitive. Though vyāyāma seems to be similar to āsana, however, they are different on a utilitarian ground.

Since the utility of āsana as prescribed by the classic texts is striving for higher truths, we would like to call this an evolution, an evolution of focus from the gross physical security
and grooming to higher and subtle nourishing levels striving for higher spiritual goals. Expansive awareness, slow and steady practice, focused attention, etc., are some of the vital components.

2.6 CONCLUSION

Vyāyāma and its various aspects, āsanas and its various dimensions were discussed along with reference to various scriptural texts. Also how vyāyāma evolves as āsana has been described using a schematic representation. On a utilitarian ground, vyāyāma has been proposed to be in one of the primitive steps in the evolutionary ladder leading to āsana, as caterpillar evolves into butterfly.
3.0: REVIEW OF SCIENTIFIC LITERATURE

Among all phases of human lifespan childhood and adolescence are the most crucial periods. During this phase, there is a radical change in metabolic systems, including hormonal regulation, changes in body fat content and body fat distribution, as well as marginal changes in insulin sensitivity (Cruz et al. 2005). Proportionately high psychological changes also occur during this period. Proportionately lifestyle disturbances and unhealthy behaviors also set in during this important phase which may influence future adult behavior and health status. (Jiménez-Pavón et al., 2011). Many scientific studies shows that physical activity helps to support, regulate and maintain optimal to good health throughout the life span. This clearly shows the importance of physical activity in daily life. These evidences strongly indicate that failing to undertake any kind of physical activity may lead to serious health concerns. Among various methods of physical fitness, yoga has been evolving as a major and popular fitness regimen giving benefits also at psychological and spiritual level. This focus of the current study being physical fitness for adolescents and yoga being an important stakeholder, the review of literature has focused on yoga for adolescents.

3.1 PHYSICAL FITNESS AND ITS RELEVANCE TO ADOLESCENTS

In order to evaluate when the life style modifications that we are witnessing in 21st century, has any influence on overall fitness. To evaluate a general consensus that performance of children and adolescents on aerobic fitness tests is declining, a meta-analysis was done comparing the results of 55 different studies conducted during 1981 to 2000 which reported using the 20m shuttle run test (20mSRT) on children and adolescents aged 6–19
years. The results clearly indicated that there was an unambiguous decline in the 20mSRT performance of children and adolescents over the last 20 years, especially in developed countries. The decline was also found not related with the country’s gross domestic product (GDP) (Tomkinson, Léger, Olds & Cazorla, 2003). Supporting the above results, in another important study, it has been emphatically shown that children who regularly practice at least 3 hours a week of sports activities are more protected against total and regional fat mass accumulation. They also increase their total lean and bone mass compared to those who do not play. Further, they are also able to maintain and regulate their physical fitness better than those who do not sport regularly (Ara et al., 2006). In a systematic review, physical activity was found to be associated with many health benefits in school-aged children and youth. The dose-response curve from various observational studies showed that physical activity and the health benefit were directly related. Further, results from various experimental studies suggested that even a moderate amount of physical activity may cause tremendous health benefits especially in high-risk youngsters like in obese, high blood pressure and so on. The review also indicated that at least moderate level intensity physical activity should be done to reap greater benefits and also higher intensity of psychical activity also leads to proportionately higher health benefits. It was also found that aerobic-based activities that strains the cardiovascular and respiratory systems have the highest health benefits (Janssen & LeBlanc, 2010). A review that evaluated various prospective observational studies showed that increased physical activity and decreased sedentary life style behaviors are protective against relative weight and fatness gains over childhood and adolescence. The review also highlighted the need for rigorous longitudinal follow-up studies to study important prevention and intervention
strategies (Must & Tybor, 2005). The obesity is becoming widespread and it is of high alarm in children. In a review important role of physical activity in the growth, development and physical health of young people, owing to its numerous physical and psychological health benefits were enumerated. Regular physical activity practiced right from the early childhood helps to positively affect mortality and longevity. Also, the need for supportive environmental factors is highlighted to have a significant impact on increasing habitual physical activity levels in children and adolescents. (Hills, King & Armstrong, 2007).

In a study on school going children, it was suggested that having good cardiorespiratory fitness can help combat ill effects of excessive fat, which could lead to imbalance in markers of insulin resistance. It was found that Homeostatic Model Assessment (HOMA) and fasting insulin were significantly correlated with body fat and waist circumference (Ruiz, Rizzo, Ortega, Loit, Veidebaum, 2007). In another study on adolescents, cardiorespiratory fitness (CRF) was found to be associated with metabolic risk. Body fat was also established to have association CRF (Rizzo et al., 2007). Mesa and co-workers (2006) conducted a study in adolescents in order to evaluate possible relationship between aerobic physical fitness and blood lipids and also a composite index of blood lipids and fasting glycaemia. The results suggested that aerobic fitness and weight management are associated with a composite index of blood lipids and glycaemia. The authors also prescribed the physical fitness model for schools. Many cross-sectional and longitudinal studies were conducted on children and adolescents to find their vulnerability towards major public health diseases and to evaluate the effectiveness of various alternative intervention strategies. Among them physical fitness has been highlighted as a key
indicator of health in childhood and adolescence. The results suggest that functional adaptation of all tissues and organs improve through moderate and vigorous levels of physical activity, making a person less susceptible to various lifestyle related degenerative and chronic diseases (Mesa et al., 2006). In another study, physical activity has been found to have direct influence on the lipid-metabolic profile in adolescents. Also aerobic capacity and muscle strength has been shown to influence the lipid-metabolic profile. Irrespective of quantity of physical activity performed, low physical fitness is associated with a less healthy lipid-metabolic profile. Lipid profile risk indicator was more predictive in males, whereas muscle strength was associated with females’ quality of physical activity. Hence the study suggests that physical fitness, especially aerobic capacity in males and muscle strength in females, can have a protective role in cardiovascular risk in adolescents (García-Artero et al., 2007).

Some studies examined possibility of physical activity (PA) as a preventive factor for low-grade inflammation. In a population of European adolescents, objective and subjective measures of PA were found to have correlation with low-grade inflammation. Various variables measured were cardiorespiratory, muscular and motor fitness functions using standardized tests along with the International Fitness Scale. Also C-reactive protein (CRP), complement factors 3 (C3) and 4 (C4), interleukin-6 and TNF-α inflammatory markers were measured. While objective measures of fitness showed inverse relationship with CRP, C3 and C4, self-reported motor fitness showed significant relationship with C3, C4 and TNF-α. Through these findings, authors suggest that high PA in adolescence may help to control low-grade inflammation. (Wärnberg et al., 2006). In another study, it has been shown that physical fitness is negatively correlated with CRP level in children and
these results were shown to be more generalizable on boys than in girls. In this study, physical fitness was measured using a treadmill testing protocol at heart rate of 170 beats per minute, and CRP level was assessed using a high-sensitivity assay, and finally their correlations were studied (Isasi et al., 2003). In a study comparing overweight and non-overweight adolescents for possible relationship between inflammatory proteins and muscle strength. Categorization of two groups were based on the body mass index. Handgrip and standing broad jump tests were taken as measures of muscle strength. Skinfold thickness was used to measure body fat and fat-free masses. Regression analysis showed that C-reactive protein, C3, and ceruloplasmin were negatively correlated with muscle strength after partialling out the effects of sex, age, pubertal status, weight, height, socioeconomic status, and cardiorespiratory fitness. Also in overweight adolescents C-reactive protein and prealbumin levels were correlated with muscle strength after partialling out various confounders like body fat and fat-free mass. Finally, the study affirms the negative relationship between low-grade inflammation and muscle strength in adolescents (Ruiz et al., 2008).

To investigate the relationship between muscular strength, body composition, and physical self-perception in adolescents, a study was conducted in which perceived body attractiveness was found to mediate the relationship between body fat percentage and physical self-worth among boys and girls. Physical self-worth is associated with different components of health-related fitness in adolescent girls and boys. In a study, psychological factors were found to predict directly and/or indirectly back muscle endurance. Associations were found between all the physical and lifestyle variables with poorer back muscle endurance performance, which is indicative of reduced back
muscle activation and/or deconditioning (Smith, O'Sullivan, Campbell & Straker, 2010). In a study to determine if physical fitness is associated with academic success in middle school students found that aerobic capacity and muscular endurance were positively related to academic achievement in middle school students. (Bass, Brown, Laurson & Coleman, 2013). Similarly, another study in order to find whether there are any correlation between health-related fitness (HRF) and academic achievement in middle school youth found that HRF was related to academic achievement in youth. Students with the highest fitness level performed better on various tests and students with the lowest fitness level performed proportionately lower in class grades (Coe, Pivarnik, Womack, Reeves, & Malina, 2012). This has been echoed in another study which attempted to find associations between physical fitness and academic achievement in diverse, urban public school children. Results again show statistically significant relationships between fitness and academic achievement (Chomitz et al, 2009). In another study to examine the role of socio economic status on possible association between physical fitness and academic achievement and in school-aged youth found that SES appears to have the strongest association with academic achievement. Also high fitness levels are positively associated with academic achievement in school-aged youth (Coe, Peterson, Blair, Schutten & Peddie, 2013).

A number of studies have shown association between physical activity, cardiovascular fitness, fatness, and cognitive function during childhood and adolescence. Study result also suggests that these variables are associated with academic achievement. Classroom-based physical activity has shown promise to improve fitness, body mass index (BMI), cognitive function, and thereby academic achievement (Donnelly & Lambourne,
Physical activity and fitness was strongly and significantly associated with academic performance. A dose-response association was observed between cardiovascular fitness and academic performance independent of other socio-demographic and fitness variables (Van Dusen, Kelder, Kohl, Ranjit & Perry, 2011). In an interesting longitudinal study, childhood obesity and its relation with academic performance was evaluated. This study longitudinally tracked students to examine the ways student physical fitness and changes in fitness match with school performance. The results suggest that there is a physical fitness achievement gap that has vital consequences for potential students' future educational and health outcomes (London & Castrechini, 2011).

The effects of physical exercise on memory and mental health were found to be mediated by behavioral and neural mechanisms. Regular exercise has shown effect on cognition, anxiety, and mood. This has further shown improvement in memory and a beneficial decrease in perceived stress (Hopkins, Davis, Vantieghem, Whalen & Bucci, 2012). In another study using electrophysiological tool, it has been shown that single session of physical activity has transient beneficial effects on cognitive control. Event-related brain potential (ERP), a following exercise regimen, participants showed increased accuracy for target trials, and P3 amplitude was greater at midline-parietal sites for both target trials and non-target trials. These results suggest that physical exercise may facilitate goal maintenance processes and enable participants to better inhibit extraneous neural activity to allocate greater attentional resources towards the updating and revision of goal representations (Scudder, Drollette, Pontifex & Hillman, 2012).
3.2 YOGA AND ITS RELEVANCE TO ADOLESCENTS

Yoga is nowadays introduced to children both at schools and at homes, as it is considered as one of the good methods to maintain health and wellbeing. In a study, it has been shown that in sub-junior athletes, integrated yoga module decreases sympathetic activity and causes a shift in the autonomic balance towards parasympathetic dominance indicating a reduction in stress. This suggests that yoga is beneficial for maintaining mental and physical fitness (Patil et al., 2013). An increase in motor speed for repetitive finger movements following yoga training was shown on a similar study done earlier on 152 children (Dash & Telles, 1999). Regular practice of yoga at an early age of 12 can help in managing anxiety and other worry symptoms during musical performances (Khalsa, 2013; Noggle et al., 2012). A study conducted to study a meditation program on resting and ambulatory blood pressure and heart rate in youth, has shown beneficial impact of meditation on blood pressure and heart rate in the natural environment in healthy youth (Barnes, 2004). Another study has shown that yoga practice, like asanas, yoga breathing, meditation and guided relaxation improve delayed recall of spatial information (Manjunath & Telles, 2004). The effect of Bhastrika, Anuloma Viloma Prāṇayāma and yogāsana on heart rate variability, general well being, cognition and anxiety levels of the medical students were studied by Chandla et al. (2013). Significant increase in high frequency (HF) components of heart rate variability and decrease in low frequency (LF) components and LF/HF were observed in the prāṇayāma groups. Significant improvement in cognition, general well being and anxiety were shown by the PGI memory scale, Hamilton- anxiety scale and psychological general well being. In the yogasana group no significant changes
were observed. The study shows that practice of slow breathing type of \textit{prānayāma} for six weeks improves cognition, anxiety and general well being and increases the parasympathetic activity. Whereas, except improvements in the general well being, there was no effect of the \textit{yogāsana} on the above parameters (Chandla et al., 2013). Yogic way of living also has a great positive influence on cognition has been highlighted in a study undertaken to assess the influence of early rising (during \textit{Brahma-muhurtha}) on tasks requiring attention and the ability to recall. Fifty four normal healthy male volunteers, with ages ranging from 16-22 years from a residential school were selected. The \textit{Brahma-muhurtha} group which woke up before 4:30 am in the morning, while the control group participants were allowed to wake up just before 7 am. \textit{Brahma-muhurtha} group after 20 days showed a significant improvement in the net scores for digit letter substitution task as well as scores for verbal and spatial memory tasks. This study suggests that rising early in the morning may influence the attention and can improve the ability to recall (Kumaran, Raghavendra & Manjunath, 2012).

Some of the yoga programs are evaluated for feasibility and qualitative evaluation has been attempted by Conboy (2013), while White (2009) has attempted to describe the philosophical basis of yoga, the basic components of a yoga practice, safety concerns, and how to locate and evaluate a yoga program for children.

Apart from the above mentioned benefits, yoga has been found to be beneficial in various clinical conditions. The following studies illustrate this aspect of clinical utility of yoga in adolescents. In a study to evaluate Yoga for anxiety Williams-Orlando (2012) has shown clinical efficacy of yoga therapy in the treatment of anxiety and panic disorder (PD) in an
adolescent female. Treatment consisted of 4 wks of individual sessions (60-min session/wk) and 6 wks of group sessions (90-min session/wk) with daily home practice. Also hospitalized condition of oncology, the quality of life has been shown to significantly influence by yoga (Geyer et al., 2011). Further, in 12 to 21 years old group has shown positive response towards yoga intervention in handling traumatized conditions (Spinazzola et al., 2011). Another study to evaluate the effect of yoga exercises on pain frequency and intensity and on quality of life in children with functional abdominal pain (Brands, 2011), has shown significant reduction of pain intensity and frequency after a 10 yoga lessons in 20 children, aged 8-18 years, with irritable bowel syndrome (IBS) or functional abdominal pain (FAP). Yoga has been found to be beneficial in exercise-induced bronchoconstriction (EIB) in children. This shows better control of asthma in children (Tahan, Eke, Bicici, 2014). Yoga has also been found useful in eating disorders like anorexia nervosa and bulimia nervosa. Individualized yoga treatment decreased eating disorder examination scores at 12 weeks, and significantly reduced food preoccupation immediately after yoga sessions (Carei, Fyfe-Johnson, Breuner & Brown, 2010).

3.3 CONCLUSION

The scientific literature was systematically studied and evidences were evaluated, leading to a clear conclusion that physical activity plays a pivotal role in development and maintenance of positive health and also in combating and recovering from various ailments, especially life style related disorders. Various fitness regimens were used and the role of yoga in physical fitness was also suggested. We can unequivocally conclude that physical activity is a must for good health and among all other regimens yoga would be most preferable giving a person holistic development of personality.