Review Article

# Can Yoga Meet the Requirement of the Physical Activity Guideline of India? A Descriptive Review


## Abstract

**Background:** Physical inactivity is the fourth major risk factor for global mortality accounting for 6% of all deaths globally and it is a key risk factor for noncommunicable disease occurrences. About 54.4% of Indians are physically inactive and <10% engage in recreational activities. On the one hand, India is spreading the message of Yoga, as a form of physical activity (PA) to the whole world. On the other hand, until now, the Physical Activity Guideline (PAG) in India is not yet fully developed. Therefore, we conducted a descriptive review of the rationality of yoga as one of the PA tools with two hypotheses - Does yoga qualify as a PA tool? Moreover, can yoga help to meet the requirement of Indian PAG?. **Methods:** An in-depth literature review was carried out using databases such as PubMed, ScopeMed, Google Scholar, and Cochrane Library. All the published articles, government reports and policy documents, which met inclusion criteria with specific reference to yoga and energy expenditure, were gathered. **Results:** The search strategy yielded 838 articles, of which 16 documents were considered for review. The review included 7 policy documents and/or studies that discussed PAGs/policy/strategy globally and 9 research studies targeted toward the energy expenditure and yoga. Huge variability was documented in the recommended PAGs globally and yoga found to be the moderate metabolic equivalents of tasks in the form of energy expenditure in this review. **Conclusion:** The compendium of physical activities should add a separate category for energy expenditure by yoga. This will help build-up newer exercise formats involving yogic physical activities to comply with the daily-recommended PA dose. In the national PA plan for India, yoga should get a prominent place. Further, in the Indian perspective, an exclusive PA plan is justified instead of a PA embedded within the national health programs *in lieu of* wider scope.


**Keywords:** *Energy expenditure, India, national physical activity plan, physical activity, physical activity guideline, yoga*


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## Introduction

Noncommunicable diseases (NCDs) account for 70% of all deaths globally every year and 80% of annual premature deaths in low- and middle-income countries.[1] According to an estimate in 2008, the death rate due to NCDs among Indians varied from 38% in males to 32% in females with an overall prevalence of PA of 14%.[2] Physical inactivity is the fourth major risk factor for global mortality accounting for 6% of all deaths globally, and it is a key risk factor for NCD occurrence.[3,4] In 2010, the cost of disability-adjusted life years (DALYs) for NCD was estimated to be 235 billion dollars, which is more than that for DALYs for communicable diseases.[5] Estimates from the WHO (2005) refers to a loss of 237 billion dollars through premature deaths from heart disease, stroke, and diabetes.[5] These deaths are largely avoidable through preventive interventions.[6] A recent study in the year 2014 found that 54.4% of Indians are physically inactive and <10% engage in recreational activities.[7] This creeping sedentarism parallels the increased NCD occurrences among Indians. PA, endorsed as the 5th vital sign, is considered to be the best buy for sedentarism.[8] To implement PA as a strategic preventive and treatment tool against NCD for the Indian population, there needs to be a large scale planning. PA recommendation at a population level is based on national physical activity guideline (PAG). The PAG for India was formulated by Misra *et al*. which is almost similar to that of the WHO recommendation.[9]

On the one hand, India became the first country to adopt a global monitoring



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framework for NCDs and has prepared a comprehensive action plan for control of NCDs. Further, a separate budgetary allocation is available for NCD prevention and health promotion, treatment, and control.[2,10] On the other hand, India has not yet developed an exclusive national action plan for PA, unlike other nations who have their exclusive national physical activity plans (NPAPs) in place.[11-13] Currently, in India, physical inactivity is covered by an integrated action plan for NCD,[2] not as an independent action plan. In addition, there is no such planning for the formulation of NPAP in the recent Indian national health policy presented in the year 2017.[11] There is an urgent need for a sustainable system to deliver structured PA promotion at the community level to more than 120 crore population, which might be financially challenging.

India's health and wellness sector score the poorest rank of 112 on a global comparison of "human capital ratings."[5] This reflects that India not only requires an urgent system reformation but also it needs massive scale changes to cope with the escalating NCD burden. This peculiar scenario demanded a closer look for broad PA promotion strategies, which are not only cost-effective, easily deliverable to a larger mass yet highly scientific. Having this context in mind, we conducted a descriptive review of rationality of yoga as one of the PA tools with two hypotheses - (a) Does yoga qualify as a PA tool? and (b) Can yoga help meet the requirement of Indian PAG?

## Methods

An in-depth literature review was carried out using the PubMed, ScopeMed, Google Scholar, and Cochrane Library. All the published articles, government reports, and policy documents with specific reference to yoga, especially Astanga Yoga and energy expenditure were gathered. Cross-references mentioned in articles were further searched to add new dimensions in exploring various aspects of yoga. Two investigators independently searched for all the potential articles in the above-mentioned search engines, and the third investigator summarized and cross-checked for duplication and finalized the articles based on the inclusion criteria. Inclusion criteria were the literature should be in the English language, must be published in the past 35 years, i.e., 1983–2018 and can be of a published article in the peer-reviewed journals or policy documents or reports. The following keywords were searched in the title or abstract of the papers: "Yoga," "Physical Activity," "Exercise," "Phys* Exercise," "Phys* Act*," "Sport*s," "Tool," "Guideline*," "Policy*," "Strategy*," "Energy," "Energy* Expense*," "Energy* Expenditure," "metabolic equivalent of tasks." Finally, documents that gratified the inclusion criteria were included for the final descriptive review.

## Results

The search strategy yielded a total of 838 references, of which 16 documents were included for further review. Therefore, the review concluded 7 numbers of policy documents or studies that discussed the PAGs/policy/strategy globally and 9 research studies targeted toward the energy expenditure and yoga. The details are shown in Table 1.

### Physical activity guideline: Flexibility in the daily dose

For adults, the WHO's recommendation of "30 min of medium to vigorous-intensity PA per day cumulating to a minimum of 150 min/week" is followed globally to curb and prevent NCDs.[4] Different forms of PA can be chosen instead of one as for example, 30 min of brisk walking daily for 5 days a week can either be undertaken as 15 min twice a day or 10 min thrice a day.[14] The compendium of PA, an invaluable living document created since 1993, lists 21 major PA headings with 821 different PA codes to choose from. The compendium is also a global resource to estimate the energy costs of different physical activities of similar metabolic equivalents task (MET) values. Similar to diet exchange programs, one can have PA exchange program of having equal METs. According to Ainsworth *et al*., walking for 1 day, strength training for 2 days (lifting weights), bicycling for 1 day and aerobic dancing for 1 day of specified intensity and duration with 2 days of rest in a week can be an alternative for 30 min of brisk walking for 5 days a week cumulating to 150 min/week; both having similar MET values of 21.5.[15] Hence, daily recommended PA level can be attained either through cumulating duration of PA or choosing a different form of exercise with similar energy cost.

Among 21 major different PA headings listed in the 2011 compendium of PA, religious PA is slated on the 20$^{th}$ heading. Yoga is a religious activity developed in India derived from an ancient philosophical treatise called Vedas since 3000 B.C.[16] In the context of PA, yoga consists of a series of stretching and flexibility exercises. Yoga is a widely practiced health-enhancing physical tool in the USA and globally.[17-20] However, 2011 compendium of PA does not mention yogic physical activities, neither under religious activity nor under any other PA heading.[15]

### Energy expenditure and yoga

Energy cost of individual Aasanas falls in the category of light intensity PA with MET values ranging from 2.2 ± 0.7, whereas in the case of Pranayamas, it falls between 1.3 ± 0.3. Flow through a series of Aasanas like in Surya Namaskar may have a different energy expenditure equating to 7.4 METs.[21] Hence, Surya Namaskar qualifies as a high-intensity PA. Many studies have found yoga as an effective exercise of light intensity activity, but literature is scanty about postures and sequences that can meet the requirements for moderate PA.[22] A combination of Aasanas in a sequence can lead to moderate intensity or high-intensity PA. Nonetheless, different forms of Pranayama can be scheduled along with the Aasanas

**Table 1: Summary of review on physical activity AND/OR yoga with relation to the energy expenditure**

| Author, year | Title of the document | Key findings |
|---|---|---|
| | **Policy docs AND/OR guidelines** | |
| Pérez M, 2013 | USA National activity plan | A comprehensive set of policies, programs, and initiatives designed to increase PA in all segments of the US population, which aims to foster a national culture that supports physically active lifestyles |
| NHS, 2010 | PA guidelines for children and young people in UK | All children and young people should engage in moderate to vigorous intensity PA for at least 60 min and up to several hours every day |
| Kahlmeier S *et al*., 2015 | National PA recommendations: Systematic overview and analysis of the situation in European countries | About half of the countries for which information was available and likely<40% of all 53 countries in the WHO European Region have developed national PA recommendations |
| Bornstein DB *et al*., 2009 | A Review of the National PA Plans of Six Countries of Six Countries | Planners should consider elements that were included in the 6 national plans evaluate the absence of other elements, particularly those that are considered crucial by the CDC and WHO |
| Matsudo V *et al*., 2002 | Promotion of PA in a developing country: The Agita São Paulo experience | A multi-level, community-wide intervention to promote PA may obtain good results if the model contains the items listed in this study |
| Patwardhan AR, 2017 | Aligning Yoga With Its Evolving Role in Health Care: Comments on Yoga Practice, Policy, Research | Yoga can help, but before it can help it needs help itself, and the various stakeholders need to reflect on the big picture so that they can collaborate on these improvements |
| Patwardhan AR, 2017 | Yoga research and public health: Is research aligned with the stakeholders' needs? | Yga-component analysis, development of a theory, adoption of a health-aligned functional typology, development and testing of a simple universal basic prototype of yoga intervention, emphasis on research about long-term adherence, and discouragement for mere proof of concept research might make yoga research serve the stakeholders better |
| | **Research studies targeting on Yoga AND/OR PA AND energy expenditures** | |
| Tyagi A *et al*., 2013 | Oxygen Consumption Changes With Yoga Practices: A Systematic Review | Number of studies report extraordinary volitional control over metabolism in advanced yoga practitioners who appear to be able to survive extended periods in airtight pits and to exceed the limits of normal human endurance |
| Larson-Meyer D, 2016 | A Systematic Review of the Energy Cost and Metabolic Intensity of Yoga | Yoga is typically classified as a light-intensity PA. However, a few sequences/poses, including Surya Namaskar, meet the criteria for moderate- to vigorous-intensity activity |
| Sherman S, 2016 | Energy Expenditure in Yoga Versus Other Forms of PA | Nonrestorative component of yoga may be a viable alternative to self-PA to achieve PA public health guidelines |
| Sallis R, 2011 | Developing health-care systems to support exercise: Exercise as the fifth vital sign | Exercise should be mandatory everywhere-although the accuracy of self-reported exercise is often low, but would argue this does not diminish the importance of the exercise vital sign, it need to be evaluated |
| Khalsa SB, 2004 | Yoga as a therapeutic intervention: A bibliometric analysis of published research studies | Yoga therapy is a relatively novel and emerging clinical discipline within the broad category of mind-body medicine, whose growth is consistent with the burgeoning popularity of yoga in the West and the increasing worldwide use of alternative medicine |
| Jerath R *et al*., 2006 | Physiology of long pranayamic breathing: Neural respiratory elements may provide a mechanism that explains how slow deep breathing shifts the autonomic nervous system | Pranayama's should be considered as physiologic mechanism through a cellular and systems level perspective, involving both neural and nonneural elements |
| Potiaumpai M *et al*., 2016 | Differences in energy expenditure during high-speed versus standard-speed yoga: A randomized sequence crossover trial | High-speed yoga results in a significantly greater caloric expenditure than standard-speed yoga. High-speed yoga may be an effective alternative program for those targeting cardiometabolic markers |
| Sherman S *et al*., 2017 | Energy Expenditure in Vinyasa Yoga Versus Walking | Yoga meets the criteria for moderate-intensity PA. Thus, Yoga may be a viable form of PA to achieve public health guidelines and to elicit health benefits |
| CeE *et al*., 2015 | Anthropometric and physiologic profiles of female professional yoga practitioners and energy expenditure during asanas execution | Chronic yoga practice is associated with (1) Values of FM %, FFM %, MVC and Wmax similar to those induced by sports requiring high degree of force and power of lower limb muscles, with maximal aerobic performance similar to control subjects; (2) Low EE during most asanas execution |

PA=Physical activity, CDC=Centre for disease control

to make an ideal recipe of a Yogic PA session. Vinyasa yoga involves moving continuously through poses and 45 min of Vinyasa yoga has been found to expend energy in medium-intensity PA.[23] Similarly, in another study of Astanga (eight-fold), yoga-based flow of Vinyasa for 30 min was found to be in medium-intensity PA band.[22] High-speed yoga leads to higher rates of energy expenditure, this is exemplified by Surya Namaskar done at higher speed is found to spend higher calories than done at a lower speed.[24] In nutshell, yoga is found to expend energy across a wide spectrum from high-to-low intensity, and hence, yoga can be a potent PA recommendation for public health purposes to derive health benefits.[25]

## Discussion

This review provides two different aspects such as variability in PAG, its flexibility globally and differential outcomes in energy expenditures from various yogic or physical activities.

### Yoga: As a physical activity tool

The yoga philosophy is a vast compilation of the ancient literature.[26,27] In mathematical terms, Yoga refers to addition.[28] In philosophical terms, yoga is a way of attaining union with the supreme consciousness or God. Thus, there are various ways to achieve the union with the supreme consciousness, namely the Raja yoga, Bhakti yoga, Jyana yoga and the Karma yoga, etc.[27,28] There are also various sub-systems of the yoga, namely the Hata yoga, Laya yoga, Nada yoga, Kriya Yoga, etc., Various components of yoga and their practices vary among all the afore-mentioned varieties of yoga.[29-32] Based on these old forms of yoga, new contemporary yoga systems were developed between the year 1906 and 2000, namely Ashtanga Vinyasa Yoga, Bihar School of Yoga, Bikram Yoga, Integral yoga (Satchidananda), Isha Yoga, Iyengar Yoga, Satyananda Yoga, Sivananda Yoga, and Vinyāsa Yoga.[33]

The practice of yoga can be divided into three broad categories: postural exercises, breath control exercises, and the meditation.[33] Postural exercise is known as Yogasana and breath control exercise is known as Pranayama. While meditation reduces the basal metabolic rate by calming down physiological processes, Yogasana, and Pranayama have varying energy expenditure.[34]

### Aasana and pranayama: As a physical activity tool

#### *Definitions of physical activity and exercise*

There are three main components of daily energy expenditure, i.e., resting energy expenditure (60%–75%), PA-related energy expenditure (15–30%), and thermic effect of food (10%).[35] The definition by Caspersen *et al*. is the most cited and most popular definition of PA, which is defined as "any bodily movement produced by skeletal muscles that result in energy expenditure."[36] PA can be known by the way it is carried out (known as PA dimension) and the basic purpose for which it is carried out (known as PA domain). The term "physical activity" should not be mistaken with "exercise." Exercise is a subcategory of PA that is planned, structured, repetitive, and purposeful in the sense that the improvement or maintenance of one or more components of physical fitness as its objective.[36] Various PA dimensions are mode, frequency, duration, and intensity while the domains include occupational, domestic, transportation, and leisure-time PA.[36] Hence, it is clear from the above discussion that Aasana is a dimension of PA.

There are several types of Pranayama which vary from the subtlest form of breath control to violent forms of inspiratory and expiratory maneuvers.[37] Baring a few Pranayama techniques, oxygen consumption rates are reported to increase in most of the Pranayamas.[34] Thus, considering the definition cited above, Pranayamas can also be considered as a PA tool, where the bodily movement is concentrated in the thoracic area.

### Does yoga qualify as a physical activity tool? Looking through the difference in the differences

PA and exercise are energy expenditure avenues by moving and propelling the body parts. A sense of physical rigor is involved while moving the body parts. Increased ventilation thus incurred is an attempt to supply the heavy demand of oxygen for energy expending tissues. Thus, exercise and increased ventilation are conjoint affairs. There is always an increased sympathetic output during exercise that balances the demands of exercise with ventilation.

Aasana is a posture that brings on body awareness and it lacks the sense of physical rigor. Postures are held for a stipulated time and then released. This posture may or may not be repeated before we move on to the next. These postures do not tax breathing to such an extent as physical exercise does. Thus, exercise and increased ventilation are not conjoint affairs while performing Aasanas. Breath control and related exercises are separate practices than postures or Aasanas. There are several forms of popular Pranayama or breathing exercises.[36] Changing the breathing is a voluntary one not due to the demand of exercise. Rate of breathing, amplitude, side of air entry (in one nostril or both sides), and air entry with different sounds, etc., are distinct characteristics of pranayama practices. Aasanas and Pranayamas are independent PA tools and generally, Aasana is practiced before pranayama in a sequence.[27,28]

From energy expenditure point of view, they can be combined in several ways to create moderate-to-high-intensity exercises. More importantly, few specific Pranayamas can produce autonomic nervous system effects such as parasympathetic dominance.[38] In a world where stress-related sympathetic disorders leading to

metabolic disorders and NCDs are rampant, parasympathetic effects of Pranayamas can confer preventive solutions.

In the practice of yoga, Aasanas and Pranayamas are practiced before practicing meditation in a sequence. In a sense before practicing mental tranquility and mental calmness in meditation, increased ventilation (breathing) incurred by Aasanas are controlled through Pranayamas or controlled breathing. Logically, yoga is more than a PA tool that encompasses both physiological and psychological techniques.

Standardizing yoga to a larger population is an area of debate as yoga dosage is mainly lineage-based depending on the school of thought. Yoga component analysis studies are also very limited.[39]

### Can yoga help to meet the requirement of Indian physical activity guideline?

India is a country of lifestyle recommendations to the world since time immemorial. It is known to boast spiritual lifestyle recommendations by the ancient philosophers.[40,41] Yoga comes from such an ancient Indian philosophical system. This is a traditional form of therapeutics, which conforms to the modern WHO definition of health as it addresses all the three health domains, i. e., physical, mental and spiritual, etc.[20] A series of yoga postures and pranayama can meet the daily-recommended dose of PA. Yoga also suits the Indian cultural life-style, and it is aptly scientific. Due to health-enhancing features yoga, it is practiced worldwide including the most developed nations.[20,26]

The support network for yoga: India has recently created a support network for applied therapeutics related to Yoga and integration of the same into modern healthcare in a holistic way. Yoga has been placed as a separate, independent health-care branch under the Ministry of Ayush of the government of India since 2014.[42] Further, in the year 2016 Center for Integrative Medicine and Research (CIMR) was founded in association with All India Institute of Medical Sciences, New Delhi. CIMR has a 7 point agenda to develop evidence-based customized care for different ailments at individual and community level using Yoga and to put forward sound foundation into research on yoga.[43] However, the integration of yoga in the Indian public health context is still awaited as much as the NPAP. This support network can be optimally utilized to induct and promote yoga into public health scene.

## Conclusion

This review concludes that a combination of Aasanas and Pranayama in a sequence can make an ideal recipe of yogic PA session leading to moderate intensity or high-intensity PA considering the energy expenditure, which further will help to meet the requirement of PAG. In contrast to the PA, where there is mainly sympathetic dominance, yoga as a PA session stimulates parasympathetic system in many of the Pranayamas. Most importantly, yoga is a comprehensive PA tool encompassing at least three dimensions of health propagated by the WHO. The compendium of physical activities should add a separate category for energy expenditure by yoga. This will help build up newer exercise formats involving yogic physical activities to comply with the PAG.

Since centuries, India has a well-publicized platform for yoga integrated with its sociocultural life. Therefore, it may not be much challenging to promote yoga as a PA tool. Yogic physical activities can be a cost-effective and scientific clinical tool that can help the Indian population to achieve the recommended level of PA. While formulating national PA plan for India, yoga should get a prominence. In the Indian perspective, induction of yoga as a focal public health tool is awaited as much as an NPAP. Further, an exclusive PA plan is justified instead of a PA plan integrated within the national health programs *in lieu of* its wider scope.

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### Conflicts of interest

There are no conflicts of interest.

## References

1. World Heath Organization. Noncommunicable Diseases (Key Facts). World Heath Organization; 2018. Available from: http://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases. [Last accessed on 2019 Jan 16].
2. World Health Organization. NCD Country Profiles – India. World Health Organization; 2011.
3. World Health Organization. WHO EMRO | Physical Inactivity | Causes | NCDs. World Health Organization; 2018.
4. World Health Organization. Global Recommendations on Physical Activity for Health. World Health Organization; 2010.
5. National Sample Survey Office (Government of India). Key Indicators of Social Consumption in India – Health. NSS 71st Round : January – June 2014. National Sample Survey Office (Government of India); 2014.
6. WHO Independent High-Level Commission on NCDs. Think Piece: Why is 2018 a Strategically Important Year for NCDs?; 2018.
7. Anjana RM, Pradeepa R, Das AK, Deepa M, Bhansali A, Joshi SR, *et al.* Physical activity and inactivity patterns in India – Results from the ICMR-INDIAB study (Phase-1) [ICMR-INDIAB-5]. Int J Behav Nutr Phys Act 2014;11:26.
8. Sallis R. Developing healthcare systems to support exercise: Exercise as the fifth vital sign. Br J Sports Med 2011;45:473-4.
9. Misra A, Nigam P, Hills AP, Chadha DS, Sharma V, Deepak KK, *et al.* Consensus physical activity guidelines for Asian Indians.

Diabetes Technol Ther 2012;14:83-98.
10. Governement of India. Report of the Woking Group on Disease Burden for the 12th Five Year Plan. Vol. 3. Governement of India; 2013.
11. Ministry of Health and Family Welfare Government of India. National Health Policy, 2017. Ministry of Health and Family Welfare Government of India; 2017.
12. Pérez M. National Physical Activity Plan. USA; 2003.
13. Bornstein DB, Pate RR, Pratt M. A review of the national physical activity plans of six countries. J Phys Act Health 2009;6 Suppl 2:S245-64.
14. Matsudo V, Matsudo S, Andrade D, Araujo T, Andrade E, de Oliveira LC, *et al.* Promotion of physical activity in a developing country: The Agita são Paulo experience. Public Health Nutr 2002;5:253-61.
15. Ainsworth BE, Haskell WL, Herrmann SD, Meckes N, Bassett DR Jr., Tudor-Locke C, *et al.* 2011 compendium of physical activities: A second update of codes and MET values. Med Sci Sports Exerc 2011;43:1575-81.
16. Centre for Disease Control. Surgeon General Report: Historical Background and Evolution of Physical Activity Recommendations. Centre for Disease Control and Prevention; 1999.
17. Khalsa SB. Yoga as a therapeutic intervention: A bibliometric analysis of published research studies. Indian J Physiol Pharmacol 2004;48:269-85.
18. Patwardhan AR. Aligning yoga with its evolving role in health care: Comments on yoga practice, policy, research. J Prim Care Community Health 2017;8:176-9.
19. Sullivan M. Yoga Therapy; 2016. Available from: https://www.yogamate.org/page/yoga-therapy-19. [Last accessed on 2018 Dec 18].
20. Singh PK. First International Day of Yoga. World Health Organization; 2015. Available from: http://www.searo.who.int/mediacentre/features/2015/international-day-of-yoga/en/. [Last accessed on 2019 Jan 14].
21. Larson-Meyer DE. A systematic review of the energy cost and metabolic intensity of yoga. Med Sci Sports Exerc 2016;48:1558-69.
22. Gabrielle L. Measurement of Energy Expenditure During Fast-Paced Vinyasa Flow Yoga. Arizona State University (Digital library); 2016.
23. Sherman S, Rogers R, Davis K, Minster R, Creasy S, Mullarkey N, *et al*. Energy Expenditure in Yoga versus Other Forms of Physical Activity: 3219 Board #124 June 2 3. Med Sci Sport Exerc 2017;49:913.
24. Potiaumpai M, Martins MC, Rodriguez R, Mooney K, Signorile JF. Differences in energy expenditure during high-speed versus standard-speed yoga: A randomized sequence crossover trial. Complement Ther Med 2016;29:169-74.
25. Sherman SA, Rogers RJ, Davis KK, Minster RL, Creasy SA, Mullarkey NC, *et al.* Energy expenditure in vinyasa yoga versus walking. J Phys Act Health 2017;14:597-605.
26. National Institute of Health. Yoga: In Depth. National Centre for Complementary and Integrative Health. National Institute of Health; 2018. Available from: https://nccih.nih.gov/health/yoga/introduction.htm. [Last accessed on 2019 Jan 17].
27. Patanjali M. Chapter 1. In: Biswal B, editor. Saddarshana Samanwya O Patanjali Yoga Darshana (Oriya). 2nd ed. Cuttack: Dharma Grantha Store, Alisha Bazar, Cuttack-2; 1983. p. 405.
28. Vivekananda S. Raja Yoga (Oriya). 3rd ed. Bhubaneswar: Secratary, Ramakrisna Math, Vivekanand Marg, Bhubaneswar; 1995. p. 224.
29. Yogapedia. Laya Yoga. Available from: https://www.yogapedia.com/definition/5309/laya-yoga. [Last accessed on 2018 May 09].
30. Wikipedia. Kriya Yoga. Available from: https://en.wikipedia.org/wiki/Kriya_Yoga.[Last accessed on 2018 May 09].
31. Wikipedia. Nada Yoga. Available from: https://en.wikipedia.org/wiki/Nāda_yoga. [Last accessed on 2018 May 09].
32. Wikipedia. Hatha Yoga. Available from: https://en.wikipedia.org/wiki/Hatha_Yoga_Pradipika. [Last accessed on 2018 May 09].
33. Wikipedia. List of Schools in Yoga. Available from: https://en.wikipedia.org/wiki/List_of_yoga_schools. [Last accessed on 2018 May 09].
34. Tyagi A, Cohen M. Oxygen consumption changes with yoga practices: A systematic review. J Evid Based Complement Alternat Med 2013;18:290-308.
35. McArdle W, Katch F, Katch V. Essentials of Exercise Physiology. 4th ed. Lippincott Williams & Wilkins; 2011. p. 237-62.
36. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. Public Health Rep 1985;100:126-31.
37. Yoga Point India. Pranayama – Breathing Exercises (From Hatha Yoga and Ashtanga Yoga). Available from: https://www.yogapoint.com/info/pranayama.htm. [Last accessed on 2019 Jan 16].
38. Jerath R, Edry JW, Barnes VA, Jerath V. Physiology of long pranayamic breathing: Neural respiratory elements may provide a mechanism that explains how slow deep breathing shifts the autonomic nervous system. Med Hypotheses 2006;67:566-71.
39. Patwardhan AR. Yoga research and public health: Is research aligned with the stakeholders' needs? J Prim Care Community Health 2017;8:31-6.
40. Government of India. Culture And Heritage – Lifestyle Values And Beliefs – Know India. Government of India; 2005. Available from: http://knowindia.gov.in/culture-and-heritage/lifestyle-values-and-beliefs.php. [Last accessed on 2018 May 09].
41. Cultural India. History of India: Ancient India. Available from: https://www.culturalindia.net/indian-history/ancient-india/index.html. [Last accessed on 2019 Jan 17].
42. Government of India. AYUSH. Available from: http://ayush.gov.in/. [Last accessed on 2019 Jan 17].
43. All India Institute of Medical Sciences New Delhi. Center for Integraive Medicine & Research. All India Institute of Medical Sciences New Delhi; 2017. Available from: https://www.aiims.edu/en/intro_cimr.html. [Last accessed on 2019 Jan 17].