

A narrative review on concept of Bala and immunity in Ayurveda physiology

Review Article

Sonam Agrawal¹, Aparna Singh^{2*}, Sangeeta Gehlot²

1. Assistant Professor, Department of Kriya Sharir, Sri Sri College of Ayurveda Science and Research Hospital, Sri Sri University, Cuttack, Odisha. India.
2. Assistant Professor, 3. Professor, Department of Kriya Sharir, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University, Varanasi. India.

Abstract

Bala in Ayurveda physiology is a multidimensional factor that refers to physical and psychological strength and the ability produced in response to antigen exposure and resistance against the manifestation of disease. It has also been synonymously used for components providing strength, nourishment, and stability to the body such as *Oja*, *Vyadhikshamatva*, *Balya*, *Sara*, *Balavridhikara Bhava*, *Prakrita Sleshma*. The *Bala* of a person is determined by a complex interaction of multifactor such as *Balavridhikara Bhava*, *Dhatu Sarata*, *Prakriti*, indulgence in dietary and behavioural activities, inherent qualities, etc. Further, it has also been opined that the *Bala* of a person cannot be assessed by just observing his body physique, as it has been seen that a person having a well-formed body does not always have good strength. In contrast, a person with a lean body may have excellent stability. As the *Bala* of a person serves as an important criterion for assessment of the severity as well as prognosis of disease, there is a need for the development of objective parameters for its assessment and implication in clinical practices.

Key Words: *Agni*, *Bala*, Immunity, Strength, Stamina.

Introduction

Ayurveda, the traditional system of medicine, rests on the fundamental principle of *Dhatu Samya* i.e., maintaining the homeostasis of the body by adopting appropriate lifestyle modifications. The acquisition of good lifestyle measures not only helps in maintaining homeostasis but also bestows one with exceptional strength. The concept of *Bala* (strength) in Ayurveda is believed to be the core factor that is responsible for providing strength to *Sharir* (body) and *Mana* (mind). However, the term *Bala* is synonymously used for such components that provide strength, nourishment as well as stability to the body viz. *Oja*, *Vyadhikshamatva*, *Balya*, *Sara*, *Balavridhikara Bhava*, *Prakrita Sleshma*.

Bala of a person cannot be assessed by just observing his body physique, as it has been seen that a person having a well-formed body does not always have good strength while a person with a lean body may have very good strength. This phenomenon has been explained by incorporating the idiom of an ant carrying a load more than her weight (1). This phenomenon also happens in the case of the presentation of clinical symptoms by the patients i.e., a person with *Avara Sattva Bala* (poor psychological strength) tends to

exaggerate even the minimal complaints while a person with *Pravara Sattva Bala* (good psychological strength) is calm even on severe condition (2). This can obscure the physician to determine the actual severity of a disease. This justification shows that, the assessment of *Dehabala* (physical strength) and *Manobala* (psychological strength) is of utmost significance for evaluating the severity of disease, planning treatment modalities as well as specific dietary regimens. Thus, this article has been planned to comprehend and integrate the concept of *Bala* in *Ayurveda* which will help the physician to assess the severity as well as prognosis of the diseases.

Material and methods

A complementary study on the scientific approach towards *Bala* was undertaken and relevant data were searched in different Ayurvedic literature as well as research articles that were published in scholarly journals indexed in scientific electronic database viz. PubMed, Google scholar, Science Direct, etc. by using keywords such as Immunity AND place of birth, Immunity AND time of birth, Immunity AND season, etc.

Review and Discussion

The word '*Bala*' has been invariably used for psychological strength as well as physical strength in a different context to denote its importance. It has been mentioned that the ability to perform all kinds of activities is *Bala* (3). It is the representative of *Utasaha* (strenuous and continued exertion) and *Upachaya*(growth) in the body (4). *Acharya Charak*

* Corresponding Author:

Aparna Singh

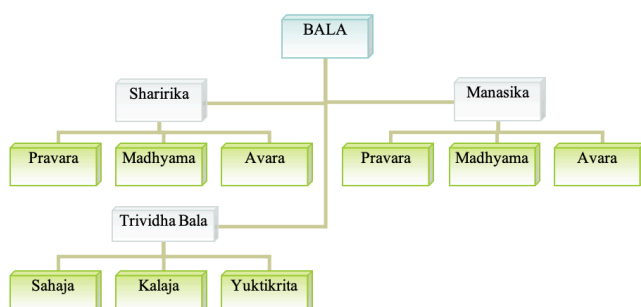
Assistant Professor, Department of Kriya Sharir,
Faculty of Ayurveda, Institute of Medical Sciences,
Banaras Hindu University,
Varanasi. India.

Email Id: appisingh23@gmail.com

has considered *Prakrita Kapha* equivalent to *Bala* and *Oja* while vitiated *Kapha* to *Mala* and the root cause of diseases (5). *Acharya Sushruta* has also considered that *Oja* and *Bala* are similar entities (6). It might be due to the fact that *Oja* and *Kapha* possess identical attributes, so an increase in one will lead to an increase in another component and vice versa. *Kapha Dosha* is responsible for the nourishment and growth of the body, steadiness, and union of different parts, which are determinants of *Bala*. But *Dalhana* has opined in different way and stated that although *Bala* and *Oja* are not the same in all aspects. *Oja* is *Dravya* having *Rasa* (taste), *Guna*(attributes), *Vipaka* (post digestive effect), *Varna* (colour), etc., which causes nourishment, growth, and development of the body and is *Praktyaksha* (perceived by sensory organs). But this is not true in respect of *Bala* i.e., it does not possess *Rasa*, *Guna*, *Vipaka* and *Varna*, and is assessed by *Anumana* (logical thinking) through activities such as *Bharvahana Shakti* (weight bearing capacity) (4). It can be said that the *Bala* of the body is the manifestation of *Oja*.

Classification of Bala

The *Bala* has been classified into different categories through different approaches such as time of their onset, strength etc. There are two components of *Bala*, i.e., *Dehabala* (physical strength) and *Manobala* (psychological strength). The *Manobala* can be categorized into three types according to the dominance of mental attributes i.e., *Sattva*, *Raja* and *Tama* which are of good, medium, and poor psychological strength respectively. Similar to this the *Dehabala* can also be categorized into *Pravara* (excellent), *Madhyama* (moderate), and *Avara Bala* (least) (7) or *Uttama* (foremost/highest), *Madhyama* (moderate) and *Heena Bala* (deficient/defective) (8). The subjects with *Pravara Bala* are capable of performing all types of physical work as well as can undergo mental stress without being affected. While the subjects with *Avara Bala* possess the contrary behaviour i.e., they get fatigued or exhausted even with the slightest exertion and becomes very anxious on even the slightest mental stress. The qualities of the person possessing *Madhyama Bala* lie in between i.e., they can withstand easily on exposure to mild and moderate stress but can not withstand excess exhaustion. *Acharya Charak* and *Vagbhatta* have mentioned three categories of *Bala* i.e., *Sahaja*, *Kalaja* and *Yuktikrita* (9-10). It has been represented in figure no. 1.



Sahaja Bala (Innate immunity)

It is the physical and psychological strength that exists in an individual right from birth and increases with time due to the natural growth and development of the *Dhatus*. Due to this inheritance, some people possess strong while some have weak immunity. It is determined by the maternal and paternal *Bala* at the time of conception and the dietary regimen followed by the mother during pregnancy. This kind of *Bala* represents the natural passive immunity present in each person since birth. This form of *Bala* corresponds to innate immunity i.e., neutrophil, dendritic cells, complement system present since birth as well as immunoglobulin transferred through placenta and breast milk from mother to neonate.

Kalaja Bala (seasonal or chronological immunity)

This *Bala* is subjected to vary according to the person's age and seasonal changes. The *Bala* of an individual in adulthood will be more compared to childhood and old age. These variations might be occurring due to the nourishment level of all *Dhatu* in different ages. During adulthood, all *Dhatu* have been formed and nourished properly while during old age, the process of degeneration took over the replenishment, leading to variation in *Bala*. As per the seasonal aspect, *Bala* is dissipated and lowest in *Adana Kala* (summer solstice) i.e., *Shishira* (late winter), *Vasanta* (spring), and *Greeshma* (summer). On the other hand, *Bala* is conserved and is highest during *Visargakala* (winter solstice) i.e., *Varsha* (rainy), *Sharad* (autumn), and *Hemanta* (early winter) seasons. This variation occurs due to the strength of the sun and moon in the summer and winter seasons. This concept was standardized on scientific parameters by a study done by Jangid C et al 2009, they have reported seasonal variation in *Bala* of an individual i.e., maximum, medium and minimum *Bala* during *Hemant*, *Vasanta* and *Varsha Ritu* respectively (11).

Yuktikrit Bala (acquired immunity)

The physical and mental strength of an individual acquired through adopting appropriate dietary and behavioural factors such as proper diet, physical activities, medicines etc. Intake of food substances like meat, ghee, pulses, adopting proper dietary regimen and lifestyle enhances the strength of an individual. The *Rasayana* (rejuvenating all the body tissues) and *Vajikarana* (nourishment of reproductive tissue and aphrodisiac) enhance the strength of an individual. The indulgence in accustomed diet articles enhances the strength while the food substances which are having contrary properties will enhance the antigenic response in the body. This description might be indicating the development of acquired immunity on exposure to antigens as well as through immunization.

Factors responsible for upsurge of strength (Balavriddhikara Bhava)

Acharya Charak has mentioned thirteen factors which are determinants of *Bala* i.e., causes an increase in *Bala* when present in an accurate way. These factors

are *Desha* (habitat), *Kala* (time of birth), *Sukhascha Kaalayoga* (favourable time), *Beejakshetragnasampat* (quality of gametes and womb), *Aaharsampaccha* (accustomed to good dietary practices), *Shareera sampacha* (well-formed body with homeostasis), *Satmyasampacha* (accustomed to good life style practices), *Sattvasampacha* (good mental strength), *Svabhavasansidhi* (inherent quality), *Youwanam* (adulthood), *Karma* (physical activity) and *Sanharsha* (blissfulness) (12). These factors affect the development of different types of *Bala*, for example *Beejakshetragnasampat*, *Svabhavasansidhi* will affect *Sahaja Bala*, *Kala*, *Yuwana* etc. will effect *Kalaja Bala* while *Aaharsampaccha*, *Satmyasampacha*, *Karma* etc. will affect *Yuktikrita Bala*. These factors can be understood in light of research in contemporary science.

Desha (Place of birth/habitat)

Three types of *Desha* i.e., *Aanupa* (marshy land), *Jangala* (arid land) and *Sadharana* (combined features of marshy and arid land) are mentioned in which the incidence of *Doshika* disorders is different i.e., *Kapha Vata* disorders in *Aanupa Desha* and *Vata-Pitta* disorders in *Jangala Desha* (13). This might be occurring due to variation in dietary and behavioural habits as wells as climatic conditions in different regions. The different geographical regions have a different climactic condition in terms of aridity, humidity, temperature, rainfall etc. These environmental factors make susceptibility of particular antigens and thus immune response. A study conducted by Young June Choe et al, 2019 has concluded that the antigen response against pneumococcal vaccine varies in accordance to different geographical regions, with greater antigen response in the western pacific region than in Europe (14).

Kala (Time of birth)

Due to the effect of season, *Bala* will be in accordance to time of birth i.e., *Aadana Kala* or *Visarga Kala*. The neonates born during *Visarga Kala* will be having a better immune response in comparison to those born during *Adana Kala*. Recent study has also depicted the variations in the concentration of immune cells in cord blood of neonates born during different seasons as well as the prevalence of disease in accordance to the season of birth. A study by Thysen AH et al; 2016; has observed difference in concentration of immune cells and mediators such as T cells, IL-2, IL-10 etc. in cord blood in different seasons i.e., higher in winter-born neonates while lowest in summer-born neonates (15). The circulating level of IgE was also found to differ in accordance to the season of birth (16). Further many researches have also shown a possible relationship between season of birth and disease outcomes such as dementia (17), Crohn's disease (18), Celiac disease (19), Hodgkin lymphoma (20), Alzhiemer's diseases (21), type 2 diabetes mellitus etc. (22). These findings might be suggestive that immunological response in early infancy plays a great role in disease manifestation during the later stage of life.

Sukhascha Kaalayoga (favourable time)

Bala gets enhanced or declined naturally in accordance to season. One-year longitudinal study in 56 cohort measured variation in immune cell over four time point during one year and observed seasonal variation in concentration of IL8 and IL 18. Further this study has also reported impact of age on concentration of several groups of T cells (23). Further, one more study has also reported seasonal as well as diurnal variation in concentration of some immune cells (24).

Beejakshetragnasampacha (quality of gametes and womb)

The quality of gametes i.e., sperm and ovum, as well as the environment of the uterine cavity are the determining factors for the appropriate growth and development of the foetus. The quality of sperm and ovum leads to a healthy progeny, while any defect in these leads to occurrence of different kinds of morbidities i.e., genetic disorders such as *Prameha* (genitourinary disorders), *Kushtha* (skin disorder) etc. These conditions somewhat affect the immune system of the individual. Further, the nutritive requirement of the growing foetus is obtained through the uterine cavity during the initial phase and later on through the placenta. The proper supply of nutrition during these phases causes appropriate development while any disturbance in it can affect the latter (25).

Aaharsampacha (accustomed to good dietary life practices)

Indulgence in a wholesome diet causes proper growth and nourishment of the body. A diet possessing all the nutrients will be beneficial for body tissues thus naturally increasing immunity. *Acharya Charak* has mentioned that indulgence in *Aahara* possessing all types of *Rasas* enhances the *Bala* while that of any single *Rasa* deteriorates the *Bala* (26).

Shareerasampacha (well-formed body with homeostasis)

Individuals having proportionate and well-nourished bodies have good *Bala* in comparison to emaciated or obese. *Acharya Charak* has mentioned that individuals with emaciated or obese bodies are prone to affliction with multiple disorders. Recent studies have also shown that underweight or overweight persons possess decreased immunological tolerance against antigens. Nowadays it is well-known fact that obesity is linked with multiple disorders such as cardiovascular disease, type 2 diabetes mellitus, insulin resistance, inflammation, tumour, autoimmune disease etc. Studies have also shown increased circulatory level of proinflammatory markers in obese individuals (27). Further, studies have also shown that being underweight is a significant risk factor for developing infectious diseases (28).

Satmyasampacha (accustomed to good diet and life style practices)

Accustomed to wholesome diet causes proper growth of the body. If a person is accustomed with the

dietary habits such as intake of milk, ghee, food articles enriched in dietary fibres and micronutrients, fruit and vegetables, following seasonal regimens, not suppresses the natural urges, follows good behaviour practices etc., will be having good stamina as compared to those who are habituated with faulty dietary habits and life style.

Sattvasampacha (good mental strength)

Person with good mental attributes have good strength, for example *Sattva Sara* and *Sattvika* individuals possess more *Bala* (2; 29). The psychological attributes such as stress, fear, grief, anger etc. undoubtedly affect the immunity of a person. It has been shown that the short-term response gives an immunoprotective response by preparing the person for flight and fight response, but chronic stress leads to immunosuppression (30). Thus, an individual, which has a tendency for overthinking and stress, has a proneness for immunosuppression and affliction with chronic disorders in long term.

Svabhavasansidhich (inheritance)

The individualistic variation in *Bala* or immunity occurs due to inheritance or psychosomatic constitution. A study has shown that the significant variation in expression of immune markers such as CD14, CD25, CD56 in accordance to psychosomatic constitution of an individual (31).

Youwanam (adulthood)

Bala is enhanced during middle age as compared to childhood and old age. It might occur due to the fact that, during childhood, the *Dhatu* are in developing phase, during old age, the process of degeneration exceeds that of replenishment, but during adulthood all *Dhatu*s are nourished as well as developed properly, resulting in good strength.

Karma (physical activity)

Acharya Charka while mentioning the effect of *Vyayama* has mentioned it as *Balavardhini* (enhancing the *Bala*) and *Dukhasahishnuta* (ability to resist the stressors) (32). Here the term *Balavardhini* can be understood in two perspectives i.e., muscular strength or stamina as well as immunity. The term *Dukhasahishnuta* might be indicating the ability of the body to combat stress as well as to resist the manifestation of disease.

Sanharsha (blissfulness)

The state of mind has also an impact on the immunological response. The emotions have direct interaction with the nervous system which in turn affects the immunological response. The negative emotions such as anger, grief etc. have been mentioned under the causative factors of different kind of diseases which shows that they increase the proneness towards the manifestation of disease. These emotions alter the digestive strength, leading to formation of *Aama* and thus affecting the nourishment level of *Dhatu* and ultimately the *Bala*. The stressful conditions affect the secretion of pro-inflammatory factors as well as other

cytokines such as cortisol. Thus, a state of joyfulness of positive emotion is important for the proper functioning of immune system.

Factors causing individual variation in Bala

Each individual possesses a different ability to resist the manifestation of diseases as well as possess a good immune response to the manifestation of disease. This ability is known as *Vyadhikshmatava* which varies from person to person i.e., some individuals possess good while some possess very poor strength to resist the appearance of disease (33). These individual variations occur in accordance with age, dietary habits, sleep, *Agni*, *Prakriti* and *Dhatu Sarata*, functional status of *Dosha*, *Dhatu* and *Mala*. The factors affecting the development of immunity has been represented in figure no. 2.

A. Age: *Bala* of the person varies in accordance to age i.e., it is best during adulthood but poor during old age. The ageing process also led to a slow responsive immune mechanism, making the old aged individuals more susceptible for inflammatory, degenerative etc. diseases (34).

B. Prakriti: The strength of an individual varies in accordance to both *Deha* and *Mansika Prakriti*. The *Kapha*, *Pitta* and *Vata Prakriti* individuals are said to be having *Uttama Bala*, *Madhyama Bala* and *Alpa Bala* respectively (35). Similarly, the *Mansika Bala* also varies in accordance to *Manasika Prakriti* of an individual. The *Sattvika*, *Rajasika* and *Tamasika Prakriti* individuals are having *Uttama Bala*, *Madhyama Bala* and *Alpa Bala* respectively (36).

C. Agni: The ingested food, after being digested and metabolised by the action of *Agni*, gets assimilated to body tissue and imparts for the sustenance of *Bala*. Due to this, *Bala* and *Agni* are considered to be having direct relationship with each other i.e., if there is good *Agnibala*, *Bala* will be good and vice versa (37).

D. Dhatu Sarata: The concept of *Dhatu Sarata* has been discussed to determine the *Bala* of an individual. The individuals having *Sarva Sara* are considered to have higher resistance in comparison to *Madhyama Sara* or *Asara* individuals (38).

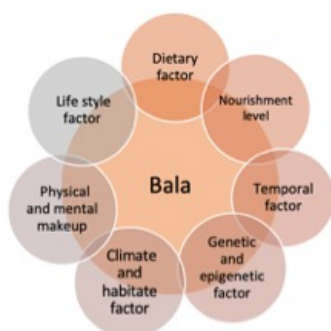
E. Functional status of Dosha: The *Sama*, *Kshaya* or *Vridhhi* state of *Dosha* also determines the *Bala* of an individual. *Dosha* are the functional entities that carry out the functions which are beneficial for body and maintain the homeostasis of body (39). *Kapha* in its normal state has been also termed as *Bala* (5). Apart from this, decrease in *Bala* has been also mentioned while describing the features of *Dosha Kshaya Vridhhi*. *Alpabala* and *Balahani* are mentioned under *Vata Vridhhi* and *Kapha Vridhhi* respectively (40).

F. Bala and Dhatu: The qualitative and quantitative status of different *Dhatu* play a significant role in the determination of *Bala*. *Rasa-Rakta Dhatu* provides the tissue with a ceaseless supply of oxygenated blood and nutrients, *Mamsa* and *Meda Dhatu* provides muscular strength, *Asthi Dhatu* provides appropriate posture while *Majja Dhatu* increases the bony strength by filling the bony cavity, and further the *Shukra Dhatu*

also increases the strength which can be understood at the level of the effect of gonadotropin hormones.

G. Nidra (sleep): An adequate amount of sleep has restorative and homeostatic impact on body tissue, thus leading to enhancement of *Bala* while inadequate sleep has opposite impact over it (41). Recent studies have shown that immune function has prominent synchrony with 24 h sleep wake cycle. The adequate amount of nocturnal sleep enhances immunological memories, immune cell differentiation and proliferation while prolonged sleep curtailment causes production of pro-inflammatory cytokines (42).

Figure Number 2- Factors affecting development of immunity



Assessment of *Bala* in Ayurveda and contemporary medical sciences

Assessment of *Bala* of a person has a great therapeutic importance as it is the core factor to decide the dose of drug, severity of diseases and line of treatment. Thus, it has been stated that a physician should always examine *Bala*, *Dosha*, *Ayu* and *Aushadha Pramana* in order to decide best management for the diseases. Two criteria have been mentioned to assess the *Bala* of a person i.e., *Vyayama Shakti* and *Dashvidha Pariksha*.

The *Dashvidha Pariksha* includes *Prakriti* (physical constitution), *Sara* (excellence of *Dhatus* or tissue elements), *Samhanana* (compactness of organs), *Pramana* (measurements of the different body parts), *Satmya* (acclimatization to wholesome diets), *Sattva* (psychic conditions), *Aahara Shakti* (ability to intake food quantity and digestive strength), *Vyayama Shakti* (strength of performing exercise) and *Vaya* (age) (43).

These factors can be directly used as objective parameter for the assessment of *Bala*. Apart from these certain other factors can also be used such as the Harvard step test (HST), physical fitness index (PFI) and maximal oxygen consumption (VO_2 max), weightbearing capacity can also be used. As *Bala* has also been mentioned in context with immune function, the parameters assessing immunological functions can also be used for the same.

Conclusion

The concept of *Bala* in *Ayurveda* physiology is a multidimensional factor that might be referring to physical and psychological strength, ability to produce antibody in response to antigen exposure and resist the

manifestation of disease as well. *Bala* of a person is determined by complex interaction of multifactor such as *Dhatu Sarata*, *Prakriti*, indulgence in dietary and behavioural activities, inherent qualities etc. Recent research has shown an association of immunity with the place of birth, time of birth, seasons, dietary factors, psychological factors, etc. These studies have been done considering the individual factor, and the multifactorial effects on the development of immunity can be done in future. The assessment of *Bala* has clinical significance as it plays an important role in determining *Rogibala*, the prognosis of the disease and administration of type and dose of drugs, choosing the proper treatment method also. Thus, objective parameters can be evaluated for the assessment of *Bala*, for understanding the disease pathophysiology as well as the treatment approach.

References

1. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Vimanasthana; Rogabhisagjitiyavimanam: Chapter 8, Verse 115. Varanasi: Chowkhambha Krishnadas academy, 2016; 925.
2. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Vimanasthana; Rogabhisagjitiyavimanam: Chapter 8, Verse 119. Varanasi: Chowkhambha Krishnadas academy, 2016; 928.
3. Thakrala KK, editor (reprint edition). Sushruta Samhita of Sushruta with Nibandhasangraha commentary of Dalhana, Sutrasthana; Vedoutaptyaadyaya: Chapter 1, Verse 28. Varanasi: Chowkhambha Orientalia, 2016; 10.
4. Thakrala KK, editor (reprint edition). Sushruta Samhita of Sushruta with Nibandhasangraha commentary of Dalhana, Sutrasthana; Doshadhatumalavridhikshayavigyaniyaadyaya: Chapter 15, Verse 19. Varanasi: Chowkhambha Orientalia, 2016; 168.
5. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Sutrasthana; Kriyantashirsiyaadyaya: Chapter 17, Verse 117. Varanasi: Chowkhambha Krishnadas academy, 2016; 368.
6. Thakrala KK, editor (reprint edition). Sushruta Samhita of Sushruta with Nibandhasangraha commentary of Dalhana, Sutrasthana; Doshadhatumalavridhikshayavigyaniyaadyaya: Chapter 15, Verse 24. Varanasi: Chowkhambha Orientalia, 2016; 170.
7. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Vimanasthana; Rogabhisagjitiyavimanam: Chapter 8, Verse 123. Varanasi: Chowkhambha Krishnadas academy, 2016; 931.

8. Thakrala KK, editor (reprint edition). Sushruta Samhita of Sushruta with Nibandhasangraha commentary of Dalhana, Sutrasthana; Agroparahaniyadhyaya: Chapter 5, Verse 37. Varanasi: Chowkhambha Orientalia, 2016; 58.
9. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Sutrasthana; Triashanaiyaadhyaya: Chapter 11, Verse 36. Varanasi: Chowkhambha Krishnadas academy, 2016; 262.
10. Kushawaha HCS, editor (1st edition). Ashtanga Hridaya of Vagbhatta with Sarvanga Sundara Commentary of Arundutta, Sharirasthana; Angavibhagoshariradhyaya: Chapter 3, Verse 78. Varanasi: Chawkhambha Orientalia, 2018; 1115.
11. Jangid C, Vyas HA, Dwivedi RR. Concept of Ritus and their effect on Bala. AYU Int Res J Ayurveda. 2009; 30:11-5.
12. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Sharirasthana; Shariravichayadhyaya: Chapter 6, Verse 13. Varanasi: Chowkhambha Krishnadas academy, 2016; 1103.
13. Thakrala KK, editor (reprint edition). Sushruta Samhita of Sushruta with Nibandhasangraha commentary of Dalhana, Sutrasthana; Aturopkraminiyadhyaya: Chapter 35, Verse 42. Varanasi: Chowkhambha Orientalia, 2016; 395.
14. Choe YJ, Blatt DB, Lee HJ, Choi EH. Associations between geographic region and immune response variations to pneumococcal conjugate vaccines in clinical trials: A systematic review and meta-analysis. Int J Infect Dis. 2020 Mar;92:261-268. doi: 10.1016/j.ijid.2019.12.021.
15. Thyssen AH, Rasmussen MA, Kreiner-Møller E, Larsen JM, Følsgaard NV, Bønnelykke K, Stokholm J, Bisgaard H, Brix S. Season of birth shapes neonatal immune function. J Allergy Clin Immunol. 2016 Apr;137(4):1238-1246.e13. doi: 10.1016/j.jaci.2015.08.041.
16. Susanto NH, Vicendese D, Salim A, Lowe AJ, Dharmage SC, Tham R, Lodge C, Garden F, Allen K, Svanes C, Heinrich J, Abramson MJ, Erbas B. Effect of season of birth on cord blood IgE and IgE at birth: A systematic review and meta-analysis. Environ Res. 2017 Aug; 157:198-205. doi: 10.1016/j.envres.2017.05.026.
17. Mooldijk SS, Licher S, Vinke EJ, Vernooij MW, Ikram MK, Ikram MA. Season of birth and the risk of dementia in the population-based Rotterdam Study. Eur J Epidemiol. 2021 May;36(5):497-506. doi: 10.1007/s10654-021-00755-3.
18. Shaw SY, Nugent Z, Targownik LE, Singh H, Blanchard JF, Bernstein CN. Association between spring season of birth and Crohn's disease. Clin Gastroenterol Hepatol. 2014 Feb;12(2):277-82. doi: 10.1016/j.cgh.2013.07.028.
19. Namatovu F, Lindkvist M, Olsson C, Ivarsson A, Sandström O. Season and region of birth as risk factors for coeliac disease a key to the aetiology? Arch Dis Child. 2016 Dec;101(12):1114-1118. doi: 10.1136/archdischild-2015-310122.
20. Crump C, Sundquist J, Sieh W, Winkleby MA, Sundquist K. Season of birth and risk of Hodgkin and non-Hodgkin lymphoma. Int J Cancer. 2014 Dec 1;135(11):2735-9. doi: 10.1002/ijc.28909.
21. Tolppanen AM, Ahonen R, Koponen M, Lavikainen P, Purhonen M, Taipale H, Tanskanen A, Tiihonen J, Tiihonen M, Hartikainen S. Month and Season of Birth as a Risk Factor for Alzheimer's Disease: A Nationwide Nested Case-control Study. J Prev Med Public Health. 2016 Mar;49(2):134-8. doi: 10.3961/jpmph.16.018.
22. Si J, Yu C, Guo Y, Bian Z, Li X, Yang L, Chen Y, Sun H, Yu B, Chen J, Chen Z, Lv J, Li L; China Kadoorie Biobank Collaborative Group. Season of birth and the risk of type 2 diabetes in adulthood: a prospective cohort study of 0.5 million Chinese adults. Diabetologia. 2017 May;60(5):836-842. doi: 10.1007/s00125-016-4200-4.
23. Ter Horst R, Jaeger M, van de Wijer L, van der Heijden WA, Janssen AMW, Smeekens SP, Brouwer MAE, van Cranenbroek B, Aguirre-Gamboa R, Netea-Maier RT, van Herwaarden AE, Lemmers H, Dijkstra H, Joosten I, Koenen H, Netea MG, Joosten LAB. Seasonal and Nonseasonal Longitudinal Variation of Immune Function. J Immunol. 2021 Jul 15;207(2):696-708. doi: 10.4049/jimmunol.2000133.
24. Wyse C, O'Malley G, Coogan AN, McConkey S, Smith DJ. Seasonal and daytime variation in multiple immune parameters in humans: Evidence from 329,261 participants of the UK Biobank cohort. iScience. 2021 Mar 1;24(4):102255. doi: 10.1016/j.isci.2021.102255.
25. Thakrala KK, editor (reprint edition). Sushruta Samhita of Sushruta with Nibandhasangraha commentary of Dalhana, Sutrasthana; Vyadhisamuddeshiyaadhyaya: Chapter 24, Verse 5. Varanasi: Chowkhambha Orientalia, 2016; 279.
26. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Sutrasthana; Yajjahapurishiyadhyaya: Chapter 25, Verse 40. Varanasi: Chowkhambha Krishnadas academy, 2016; 448.
27. Ilavská S, Horváthová M, Szabová M, Nemessányi T, Jahnová E, Tulinská J, Líšková A, Wsolová L, Staruchová M, Volkovová K. Association between the human immune response and body mass index. Hum Immunol. 2012 May;73(5):480-5. doi: 10.1016/j.humimm.2012.02.023.
28. Dobner J, Kaser S. Body mass index and the risk of infection - from underweight to obesity. Clin Microbiol Infect. 2018 Jan;24(1):24-28. doi: 10.1016/j.cmi.2017.02.013.
29. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Vimanasthana; Rogabhisagjitiyavimanam: Chapter 8, Verse 111. Varanasi: Chowkhambha Krishnadas academy, 2016; 924.

30. Dhabhar FS. Effects of stress on immune function: the good, the bad, and the beautiful. *Immunol Res.* 2014 May;58(2-3):193-210. doi: 10.1007/s12026-014-8517-0.
31. Rotti H, Guruprasad KP, Nayak J, Kabekkodu SP, Kukreja H, Mallya S, Nayak J, Bhradwaj RC, Gangadharan GG, Prasanna BV, Raval R, Kamath A, Gopinath PM, Kondaiah P, Satyamoorthy K. Immunophenotyping of normal individuals classified on the basis of human dosha prakriti. *J Ayurveda Integr Med.* 2014 Jan;5(1):43-9. doi: 10.4103/0975-9476.128857.
32. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). *Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Sutrasthana; Naveganadharaniyadyaya: Chapter 7, Verse 31-32.* Varanasi: Chowkhambha Krishnadas academy, 2016; 180.
33. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). *Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Sutrasthana; Vividhashitapitiyadyaya: Chapter 28, Verse 6.* Varanasi: Chowkhambha Krishnadas academy, 2016; 594.
34. Weyand CM, Goronzy JJ. Aging of the Immune System. *Mechanisms and Therapeutic Targets. Ann Am Thorac Soc.* 2016 Dec;13 Suppl 5(Suppl 5): S 4 2 2 - S 4 2 8 . doi: 1 0 . 1 5 1 3 / AnnalsATS.201602-095AW.
35. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). *Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Vimanasthana; Rogabhisagitiyavimanam: Chapter 8, Verse 97-99.* Varanasi: Chowkhambha Krishnadas academy, 2016; 594.
36. Thakrala KK, editor (reprint edition). *Sushruta Samhita of Sushruta with Nibandhasangraha commentary of Dalhana, Sutrasthana; Aturopkraminiyadyaya: Chapter 35, Verse 38.* Varanasi: Chowkhambha Orientalia, 2016; 393.
37. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). *Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Sutrasthana; Ritucharyadyaya: Chapter 6, Verse 9.* Varanasi: Chowkhambha Krishnadas academy, 2016; 924-925.
38. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). *Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Vimanasthana; Rogabhisagitiyavimanam: Chapter 8, Verse 102-1115.* Varanasi: Chowkhambha Krishnadas academy, 2016; 924-925.
39. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). *Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Sutrasthana; Maharogaadyaya: Chapter 20, Verse 9.* Varanasi: Chowkhambha Krishnadas academy, 2016; 393.
40. Thakrala KK, editor (reprint edition). *Sushruta Samhita of Sushruta with Nibandhasangraha commentary of Dalhana, Sutrasthana; Doshadhatumalavridhikshayavigyaniyaadyaya: Chapter 15, Verse 13.* Varanasi: Chowkhambha Orientalia, 2016; 165.
41. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). *Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Sutrasthana; Ashtanidintaiyadyaya: Chapter 21, Verse 36.* Varanasi: Chowkhambha Krishnadas academy, 2016; 405.
42. Besedovsky L, Lange T, Born J. Sleep and immune function. *Pflugers Arch.* 2012 Jan;463(1):121-37. doi: 10.1007/s00424-011-1044-0.
43. Dwivedi LD, Dwivedi BK, Goswami PK, editors (2nd edition). *Charak Samhita of Agnivesha with Ayurvedadeepika commentary of Chakrapanidutta, Vimanasthana; Rogabhisagitiyavimanam: Chapter 8, Verse 94.* Varanasi: Chowkhambha Krishnadas academy, 2016; 917.
