

CHAPTER 5

MATERIALS & METHODS

Key Messages

- Participants were recruited from the “Ramana Maharishi Academy for the Blind” in Bangalore.
- 83 visually impaired children, yoga (n=41) and control (n=42) were participated in this study.
- This was a non randomized, single-blind, waitlist control trial.
- Intervention was provided to the yoga group for 60 minutes, 5 days per week for 16 weeks.
- Yoga was taught using a specially developed five steps method.
- A yoga module was designed, validated with the help of 25 experts and further feasibility of the yoga module was measured on nine totally blind children.
- Participants’ physical & psychological variables were assessed using standardised tools.

5.0 MATERIALS & METHODS

5.1 PARTICIPANTS

5.1.1 Sample size

The sample size was calculated based on an effect size (0.78) obtained from a previous pilot study of changes in proprioception in visually impaired students (Mohanty et al., 2014). Sample size was calculated using G*Power software, Version 3.0.10, where the level of alpha was $\alpha = 0.05$, power $\beta = 0.90$ and the recommended sample size was [n =72 (36+36)].

Eighty three children with VI aged 9-16 years were enrolled by convenience sampling. They were divided into two groups: yoga (n = 41), and control (n = 42). Children were not involved in any other vocational training program considered in the yoga group and controls continued to participate in normal professional training. Before participation, all children underwent psychological evaluations, including appropriate intelligence tests for determining intellectual disabilities by the Institutional psychologist team. The children were active and proficient in their ability to move about within their environment by themselves to carry out their regular activities. None had any other identifiable disability, neurological, or other disorder. Visual impairments diagnosed by the ophthalmologist and records of the children's medical examinations were available in the school.

5.1.2 Inclusion Criteria

Participants, who had (a) Congenital blindness (b) aged 9 to 16 years (c) able to understand both English and the regional Indian language (Kannada) (d) no prior exposure to yoga, and (f) agreed to provide written informed consent, were included in the study.

5.1.3 Exclusion criteria

Children with (a) multiple impairments, (b) any injury restricting practice of yoga, (c) any deformity in the upper and lower extremities, (d) deficit in other sensory systems, (e) or additional physical and psychological disabilities, were excluded from the study.

5.1.4 Source

Participants were recruited from the Ramana Maharishi Academy for the Blind (residential school) in Bangalore, South India. This is the second oldest blind school of Karnataka with 130 students studying from primary class to 10th std. First the study protocol was explained to the school authorities, and, after obtaining their permission, all students were informed and invited to participate. Children who volunteered to join the study, and satisfied the inclusion criteria without satisfying exclusion criteria, were included in the study.

5.1.5 Ethical clearance and informed consent (Appendix 1)

Approval for the research was obtained from SVYASA's Institutional Ethics Committee in accordance with the Declaration of Helsinki, after they had reviewed the application. Written informed consent was obtained from the school administration, parents or guardians, and each participant, after explaining the experimental procedure to them in detail.

5.2 DESIGN

This was a non randomized, single-blind, waitlist control trial, with the two groups matched on age, gender, height, weight and degree of blindness. Both groups were assessed at baseline and after 16 weeks. The yoga group participated in one hour of yoga practice, five days per week, while the control group spent the same amount of time in ostensibly comparable activities, learning dance, preparing hardboard, or playing games.

5.2.1 Blinding and masking

Participants' data was presented for analysis using numerical identifiers, ensuring that the statistician was blind to the source of the data. Masking participants to a yoga intervention is not possible; however, the trained research assistants were masked to participants' group assignment during data collection and analysis.

5.3 INTERVENTION

Intervention was provided to the yoga group for 60 minutes, 5 days per week for 16 weeks by a trained yoga instructor already having experience with children who are visually impaired with the help of two other certified yoga instructors. For better learning, the yoga group (n=41) was divided into four subgroups of 10 or 11 students each. The classes were conducted separately for each group for the same period of time. Audio cassettes with detailed instructions of all practices were also provided. Individual care was provided to ensure that they could understand, feel and perform each practice accurately. Each practice (especially the asanas) was taught using the five different modes of teaching which are explained below.

5.3.1 Mode of teaching yoga

I. **Verbal guidance:** Verbal communication is a prime medium for children with VI, since they are unable to make eye contact, or perceive facial expressions or gestures. Clear, concise, direct, simple and complete descriptions of each yoga practice were given in the student's local language,



Kannada. Also to avoid possible adverse effects each yoga posture's limitations and contraindications were explained.

II. Tactile modelling: Children with VI greatly rely on the sense of touch as an additional mode of learning. For better understanding and to create interest, a thick paper cut-out model of each asana was prepared and distributed among the participants who were instructed to touch and feel the model until they thought they really understood the body position.



III. Step by step teaching: Step-by-step instruction constitutes a strategic teaching method that divides each practice into sub steps to understand, memorize, and perform comfortably. Division into sub steps means that each step can be taught sequentially. It is more effective than verbal guidance, and, though overall instruction may require a longer time period, helps students gain better proficiency.

IV. Learning in a group: Practices become easier to learn when participants can touch and feel an instructor or peer performing the movements. All participants were divided into groups of four or five of the same gender, and the asked to stand in circles with a



demonstrator student at the center. As the demonstrator performed the posture according to the yoga instructor's directions, members of the group touched and felt the body and limb positions.

V. Physical assistance with verbal guidance: An effective teaching technique to improve performance of children with VI. When other modes of teaching fail to provide clear conception of a practice, this strategy becomes appropriate to teach a skill. While students performed the practices, the yoga assistants corrected their



postures individually by guiding their limbs into the correct positions, or at least better positions.

Asanas (physical postures) were taught using all the five steps described above. Breathing and loosening practices could not use the second, “tactile model” step as they are not static postures. During relaxation practices, Step 1, “verbal instruction”, was sufficient as no physical movements are involved. Each step has its own uniqueness and importance for teaching yoga efficiently. Once the practices were clearly understood, the children were taught using only verbal cues for each movement.

Although some participants found certain yoga postures difficult at the beginning of the intervention, most participants could perform them by the end of the study. Remarkably, complete class attendance was achieved by all participants. No adverse events were reported. Most students found adjustment to the new routine difficult, while for some comprehension was limited. A few were nervous and afraid of falling. Some could not recognize the direction of the instructor’s voice, and faced the opposite direction, but within a week, all started taking more interest and were more positive about learning yogic practices. With certain practices, most of the students felt uncomfortable: balancing asanas, dynamic practices, and those where the body needs to be lifted from the ground.

Control group participants were requested to maintain their routine activities and not to begin yoga or any mind-body program during the course of the study. At the end of the study period, the wait-list control group was invited to participate in the yoga program.

5.3.1.1 Children’s preferred mode of learning

Participants responded to a questionnaire concerning their preferred learning method (order of preference for the five steps), i.e., which strategy they preferred, in a semi structured interview.

All 41 participants were interviewed, 33 responded for their order of preference for the five steps of learning yoga. Details are given in results section, 7.2.

5.4 Development, Validation and Feasibility of the Yoga Module

This part of the study comprised the following steps.

5.4.1 Developing a yoga module

The development of the yoga module was undertaken by considering a list of target symptoms (both physical and psychological) of children with VI, and then yoga practices to remedy them were determined from an extensive literature review of benefits of yoga practices for normal children (Details in Table 5.4.1). A yoga module was designed in light of *Panchakosha* theory based on (i) a methodical review of yoga texts, both ancient (Muktibodhananda, 2012; Vasu, 2005) and contemporary (Iyenger, 2008; Nagarathna & Nagendra, 2013; Saraswati, 2008) (ii) authors' 4 years' working experience with children with VI, (iii) previous study of Mohanty et.al., (2014), (iv) consideration of scientific results of specific yoga practices on children with normal vision (e.g., sun salutation and yogic breathing techniques) (Bhavanani, Udupa, & Ravindra, 2011; Kumar, Sivapriya, & Thirumeni, 2011; Sivapriya, Suba, & Thirumeni, 2010) and besides that, (v) suggestions from the physical trainers of visually challenged children (Table 5.4.1.1). The first such yoga module contained 33 yoga practices including breathing exercises, loosening practices, yoga postures (*Asana*), yogic breathing techniques (*Pranayama*), meditation and relaxation practices, to promote all round development in the duration of one hour.

5.4.2 Validation of the yoga module

Validation was done in the scientifically accepted way, by 25 experts (19 yoga experts and 6 physical trainers). The yoga experts were included from various yoga schools of India: SVYASA Yoga University (16%), Bihar School of Yoga (8%), Art of Living (8%),

Kaivalyananda (8%), Patanjali Yoga Peetha (16%), and 20% were from multiple schools of yoga. The physical trainers with expertise in training visually challenged children and basic knowledge of yoga constitutes rest of the 24% of the experts involved in this validation. Before taking suggestions from the physical trainers each practice was explained in detail, and a demo class was provided for them. A request letter was either sent through the mail, or given personally to the experts to participate in the study; after receiving their consent the scoring sheet was provided for the validation.

Validation was carried out in two rounds of iteration (Figure 5.4.2): In the first, 12 experts (9 yoga and 3 physical trainers) rated each practice on a scale of 0-4 (0- not useful, 1- a little useful, 2- moderately useful, 3- very useful, 4- extremely useful). Suggestions supported by over 50% of the experts were incorporated into the yoga module and formed a part of next round of iteration. In the second phase, the new list was given to another 13 experts (10 yoga and 3 physical trainers) for scoring (**Appendix 2**) and data obtained were analysed using Lawshe's Content Validity Ratio (CVR) (Lawshe, 1975). Items with a CVR of 0.37 or more were retained in the list.

A few qualitative responses were also collected from the experts to determine the appropriateness of the duration of each yoga session and the whole yoga training program. As per the experts' suggestions the yoga module for children with VI was finalised (Table 5.4.2).

5.4.3 Feasibility of the study

Feasibility of the study was tested on nine children with VI (6 boys, 3 girls) aged 13.56 ± 2.79 enrolled from a residential school for the blind, "Sahyog Vishesh Avasik Vidyalaya", Hoshangabad, Madhya Pradesh, India. Participants who were: (a) totally blind since birth, (b) aged 9 to 15 years, (c) no prior exposure to yoga, and (d) agreed to provide written informed consent were included in the study. Children with (a) multiple impairments, (b) any injury

restricting the practice of yoga, (c) deficit in other sensory systems, and (d) additional physical or psychological disabilities were excluded from the study.

Participants' explosive power of upper and lower limb was assessed by Tennis Ball Throw (TBT) and Standing Vertical Jump (SVJ) tests respectively (Fjørtoft, Pedersen, Sigmundsson, & Vereijken, 2011). In TBT test, children threw the tennis ball as far as possible by their right hand keeping their left foot in front. The better of two attempts was recorded. Distance thrown was measured in meters. In SVJ test, the participants stood straight alongside the wall and raised their hand straight up and touched the wall at the highest tip of their hand and left a mark with the colour which was painted in their hand. The feet were flat on the ground. Then the participants jumped from a standstill position to as high as possible. At the peak of their jump, they touched the wall and left a mark. The difference in distance between the reach height and the jump height was the score. Better of two attempts (measured in centimeters) was considered for analysis. Participants were also completed a qualitative exit survey.

Table 5.4.1: Specific Needs of Visually Impaired Children and their Remedies through Yoga			
Problems of children with visual impairment compared to normal sighted children (ref)	Target Koshas	Remedy Through yogic methodology	Benefits of yoga in normal sighted children (ref)
Lower <ul style="list-style-type: none"> • Physically active (Houwen et al., 2009) • Physically fit (Lieberman et al., 2010) • Balance & Co-ordination (Navarro et al., 2004) 	Annamaya Kosha (Sheath of physical awareness)	Achieving physical awareness through <i>1)Asanas</i> <i>2)Loosening exercises</i> <i>3)Suryanamaskar</i> <i>all practiced with breath awareness</i>	Increased <ul style="list-style-type: none"> • Physical fitness • Coordination (Telles et al., 2013) • Muscle strength (Chen et al., 2009)
Higher <ul style="list-style-type: none"> • Rate of breathing • Heart rate • Diastolic blood pressure (Telles et al., 1999) 	Pranamaya Kosha (Sheath of pranic flow)	Regulating/ balancing the prana energy through pranayama/ kriya <i>1) Kapalabhati kriya</i> <i>2) Vibhagiya Pranayama</i> <i>3) Nadi shuddhi</i> <i>4)Bhramari</i>	Improved <ul style="list-style-type: none"> • cardio-pulmonary fitness (Raub, 2002) • Respiratory muscle strength (D'Souza & Avadhany, 2014)
Higher <ul style="list-style-type: none"> • Anxiety level (Bolat et al., 2011) • Disturbed mind (Van Hasselt & Kazdin, 1986) 	Manomaya Kosha (Sheath of mental activities)	Activating the mind/ channelizing the mind in right direction through <i>1)Nadanusandhana</i> (A,U,M repetition) <i>Devotion and Bhakti</i> <i>2) Relaxation techniques: IRT/QRT/DRT</i> <i>bridged in between physical practices</i>	Decreased <ul style="list-style-type: none"> • Cortisol level (Butzer et al., 2015) • Anxiety (Telles et al., 1997)
Lower <ul style="list-style-type: none"> • Quality of life (Chadha & Subramanian, 2010) • Self concept & Self confidence (Mishra & Singh, 2012) • Emotional stability 	Vijnanamaya Kosha (Sheath of self knowledge)	Fear reduction through <i>1)Yogic counselling; happiness analysis</i> <i>2)Positive resolve in relaxation, following every yoga session</i>	Improved <ul style="list-style-type: none"> • Quality of life (Wurz et al., 2014) • Self-esteem (Telles et al., 2013)
Poor adjusted in <ul style="list-style-type: none"> • Emotional • Social • Educational Ground (Huurre & Aro, 1998) 	Anandamaya Kosha (Sheath of bliss)	<i>1)Work and study without getting stressed i.e. not expecting the fruit of action - Karma yoga</i> <i>2) Krida yoga enjoy what you do.</i>	Decreased <ul style="list-style-type: none"> • Stress (Telles et al., 1997)

Table 5.4.1.1: References to Yoga Practices in Classical and Modern Yoga Texts			
Practice name	Ref from Ancient texts	Meaning	Modern References
आसन <i>Āsana</i>	कुर्यात्तदासनं स्थैर्यमारोग्यं चाङ्गलाघवम् ॥ ह यो प्र १/१७ <i>Kuryāttadāsanam sthairyamārogyam cāṅgalāghavam</i> <i>Ha Yo Pra 1/17</i>	Brings lightness and steadiness of body and mind, i.e. health	Revitalizes and relaxes the body and calms down the mind ^[1] . Releases mental tensions by dealing with physical level ^[2] .
वृक्षासन <i>Vṛkṣāsana</i>	वामोरूनूलदेशे च याम्यं पादं निधाय तु । तिष्ठेत् वृक्षवद्भौ वृक्षासनमिदं विदुः ॥ घे सं २/३६ <i>Vāmorunūladeśe ca yāmyam pādāni nidhāyatu</i> <i>tiṣṭhetta vṛkṣavadbhau vṛkṣāsanamidam</i> <i>viduḥ</i> <i>Ghe Sanit 2/36</i>	Standing on one leg, bending the other, and placing the foot at the top of the thigh standing like a tree, is called the Tree- posture.	Tones muscles in the lower extremities improving balance ^[2, 3] .
वज्रासन <i>Vajrāsana</i>	जङ्घाम्यां वज्रवत्कृत्वा गुदपार्श्वे पदावृभो । वजासनं भवेदेतद्योगिनां सिद्धिदायकम् ॥ घे सं २/१२ <i>Jaṅghāmyāni vajravatkṛtvā gudapārśve padāvṛbho</i> <i>Vajāsanaṁ bhavedetadyogināni</i> <i>siḍḍhidāyakam</i> <i>Ghe Sanit 2/12</i>	Make the thigh tight like adamant and place the feet beside the behind. This is <i>Vajrāsana</i> it brings the Yogi subtle abilities.	Makes ankle flexible, stops flat feet, and heel pain. Increases awareness ^[1] ; digestive efficiency; helps stomach ailments, alleviates menstrual disorders ^[2] .
पश्चिमतानासन <i>Pāścimatān Āsana</i>	उदयं जठरानलस्य कुर्यादुदरे काश्यमरोगतां च पुंसाम् ॥ ह यो प्र १/२९ <i>Udayam jaṭharānalasya kuryādudare kāśyamārogaṭāni ca puṁsām</i> <i>Ha Yo Pra 1/29</i>	Kindles the gastric fire, reduces belly fat giving aspirants better health.	Rejuvenates whole spine, stimulates and tones digestive system ^[1, 2, 3] . Removes excess weight ^[2] .
मत्स्येन्द्रासन/ वक्रासन <i>Matsyendrāsana/ Vakrāsana</i>	मत्स्येन्द्रपीठं जठरप्रदीप्तं प्रचंडरुग्मंडलखंडनास्त्रम् ॥ ह यो प्र १/२७ <i>Matsyendrapīṭham jaṭharapradīptam</i> <i>pracaṇḍarugmaṇḍalakhāṇḍanāstram</i> <i>Ha Yo Pra 1/27</i>	Increases the digestive fire to such an incredible capacity that it is the means of removing diseases.	Tones spine; helps back & digestive problems, regulates adrenal gland, liver, pancreas ^[1, 2] and kidneys ^[2] . Helps T2DM, and lung capacity ^[1] .
भुजङ्गासनम् <i>Bhujāṅgāsanaṁ</i>	देदाग्निर्वद्धते नित्यं सर्वरोगविनासनम् । जागर्ति भुजगी देवी भुजगासनसधनात् ॥ घे सं २/४३ <i>Dedāgnirvaddhate nityam sarvarogavināsanam</i> <i>Jāgarti bhujagī devī bhujāgāsanasadhanāt</i> <i>Ghe Sanit 2/43</i>	Increases bodily heat, destroys all diseases.	Tones spine & benefits all spinal problems ^[1, 2, 3] . Reduces abdominal fat. Useful in bronchial problems ^[1] . Alleviates gynaecological disorders, benefits all abdominal organs, esp., liver and kidneys ^[2] .

<p>शलभासन <i>Śalabhāsana</i></p>	<p>अध्यास्यः शेते करयुग्मं वक्षेभूमिवष्टभ्य करयोस्तलाभ्याम् । पादौ च शून्ये च वितस्ति चोर्ध्वं वदन्ति पीठं शमभं मुनीन्द्रः ॥ घे सं २/३९ <i>Adhyāsyaḥ śete karayugmani vakṣebhūmivāṣṭabhya karayostalābhyām Pādaū ca śūnye ca vitasti cordhvaṇi vadanti pīṭhani śamabhani munīndraḥ Ghe Sanī 2/39</i></p>	<p>Lie on the ground face downwards; place the two hands on the ground with palms upwards, raise the legs in the air 50 cm high. This is the Locust posture.</p>	<p>Relieves backache, benefits digestion & its disorders ^[1, 2, 3]. Tones kidneys & hip muscles. Reduces fat on thighs and buttocks ^[1]. Tones and balances liver function ^[2].</p>
<p>धनुरासन <i>Dhanurāsana</i></p>	<p>पादांगुष्ठौ तु पाणिभ्यां गृहीत्वा श्रवणावधि । धनुराकर्षणं कुर्याद्धनुरासनमुच्यते ॥ ह यो प्र १/२५ <i>Pādāṅguṣṭhau tu paṇibhyāṇi gṛhītvā śravaṇāvadhī Dhanurākaraṣaṇaṇi kuryādghanurāsanaṇi Ha Yo Pra 1/25</i></p>	<p>Holding the toes with the hands, pull them up to the ears as if drawing a bow. This is the <i>dhanurāsana</i>.</p>	<p>Improves function of digestive, excretory and reproductive organs; helps gastrointestinal disorders. Stimulates back, manages problems, increasing flexibility ^[1, 2, 3].</p>
<p>मकरासन <i>Makarāsana</i></p>	<p>शिरश्च ध्रुत्वा करदण्डयुग्मेदेहाग्निकारं मकरासनं तत् ॥ घे सं २/४० <i>Śiraśca dhruvā karaṇḍayugmedehāgnikāraṇi makarāsanaṇi tat Ghe Sanī 2/40</i></p>	<p>Increases bodily heat.</p>	<p>Relaxes back muscles relieving backache ^[2, 3]. Beneficial for lung ailments inc. asthma ^[2].</p>
<p>विपरीतकरनी <i>Viparītakaraṇī</i></p>	<p>नित्यमभ्यासयुक्तस्य जठराग्निविवर्धिनी ॥ ह यो प्र ३/८० <i>Nityamabhyāsayuktasya jaṭharāgnivivardhinī Ha Yo Pra 3/80</i></p>	<p>This practice increases the gastric heat of a regular practitioner.</p>	<p>Helps in thyroid ^[1, 2], varicose veins, hernia, piles, menstrual disorders, sciatica & low backache. Reduces fat on thighs/buttocks ^[1]. Balances respiratory and digestive systems. Relieves stress, clears psychological disturbances & improves immunity ^[2].</p>
<p>मत्स्यासनम् <i>Matsyāsanaṇi</i></p>	<p>मत्स्यासनन्तु रोगहा ॥ घे सं २/२१ <i>Matsyāsanaṇtu roghā Ghe Sanī 2/21</i></p>	<p>Matsyasana is the destroyer of diseases.</p>	<p>Good for respiratory problems, ^[1, 3] inflamed and bleeding piles ^[3, 2] diabetes ^[1], abdominal ailments, & backache; regulates thyroid, boosts immune system ^[2].</p>
<p>शवासन <i>Śavāsana</i></p>	<p>शवासनं श्रान्तिहरं चत्तविश्रान्तिकारकम् ॥ ह यो प्र १/३२ <i>Śavāsanaṇiśrāntiharāṇicittaviśrāntikāraṇam Ha Yo Pra 1/32</i></p>	<p>wards off fatigue and brings mental repose.</p>	<p>Relaxes whole psycho-physiological system ^[2, 3]. Develops body and mind awareness ^[2].</p>

<p>प्राणायाम <i>Prāṇāyāma</i></p>	<p>प्राणायामेन युक्तेन सर्वरोगक्षयो भवेत् ॥ ह यो प्र २/१६ <i>Prāṇāyāmena yuktena sarvarogakṣayo bhavet</i> <i>Ha Yo Pra 2/16</i></p>	<p>By proper practice of <i>prāṇāyāma</i> all diseases are annihilated.</p>	<p>Lowers stress & anxiety levels by harmonising the <i>prāna</i>: induces: tranquillity, clarity of thought ^[1]. physical & mental stability ^[2].</p>
<p>कपालभाति <i>Kapālabhāti</i></p>	<p>कपालभातिर्विख्याता कफदोषविशेषणी ॥ ह यो प्र २/३६ <i>Kapālabhātirvikhyātā kaphadoṣaviśeṣaṇī</i> <i>Ha Yo Pra 2/36</i></p>	<p>The destroyer of disorders caused by phlegm.</p>	<p>Activates digestive organs ^[1, 2, 3]. Cleanses lungs helps respiratory disorders, balances and strengthens nervous system, removing drowsiness ^[1, 2], activates head region ^[3].</p>
<p>नाडीशोधन <i>Nāḍīśodhana</i></p>	<p>शुद्धा नाडिगणा भवन्ति यमिनां मासत्रयादुर्ध्वतः ॥ ह यो प्र २/१० <i>Śudhā nāḍigaṇā bhavanti yamināṃ māsatrayādurdhvataḥ</i> <i>Ha Yo Pra 2/10</i></p>	<p>Purifies all <i>Nādi</i> within three months.</p>	<p>Cleanses nasal tract, metabolic rate down, increases digestive fire and appetite ^[1]. Lowers level of stress and anxiety, benefits respiratory disorders i.e. bronchial asthma, nasal allergy, bronchitis ^[1, 2]. Calms the mind ^[3].</p>
<p>भ्रामरी <i>Bhrāmari</i></p>	<p>चित्ते जाता काचिदानन्दलीला ॥ ह यो प्र २/६८ <i>Citte jātā kācidānandalīlā</i> <i>Ha Yo Pra 2/68</i></p>	<p>indescribable blissful experience fills the mind.</p>	<p>Relieves stress, reducing anger, anxiety, increases body's healing capacity. Strengthens & improves voice. Harmonizes mind directs awareness inside ^[1, 2] eliminates throat ailments. Helpful in insomnia ^[1, 2, 3].</p>
<p>धौति <i>Dhauti</i></p>	<p>कासश्वासप्लिहकुट्टं कफरोगाश्च विंशतिः । धौतिकर्मप्रभावेन प्रयान्त्येव न संशयः ॥ ह यो प्र २/२५ <i>Kāsaśvāsaplihakuṭṭaṃ kapharogaśca viṃśatiḥ</i> <i>dhautikarmaprabhāvena prayāntyeva na saṃśayaḥ</i> <i>Ha Yo Pra 2/25</i></p>	<p>Coughs, asthma, diseases of the spleen and the skin and the twenty varieties of diseases caused by excess of phlegm get cured.</p>	<p>Muscular contractions in stomach walls stimulate abdominal organs, removes excess mucus, helps respiration ^[1, 2]. & emotional blocks ^[2].</p>
<p>नेति <i>Neti</i></p>	<p>कफदिषा विनश्यन्ति ॥ घे सं १/५१ <i>Kaphadiṣā vinaśyanti</i> <i>Ghe Saṃ 1/51</i></p>	<p>Rectifies problems with mucosa.</p>	<p>Clears nasal passages, removes cold, headache, sinusitis, bronchitis; helps olfactory nerves ^[1, 2]. Alleviates anxiety, anger, and depression; removes drowsiness; balances body and mind ^[2].</p>
<p>^[1] Nagendra HR, Nagarathna R. Yoga for Health. 1st ed. India: Vivekananda yoga research foundation; 2008. ^[2] Saraswati S. Asana, Pranayama, Mudra Bandha. 4th ed. India: Yoga publication trust; 2008. ^[3] Iyenger BKS. Light on Yoga, 37th ed. London: Herper Collins Publishers; 2008.</p>			

Figure 5.4.2: Process of Validation of the Yoga Module

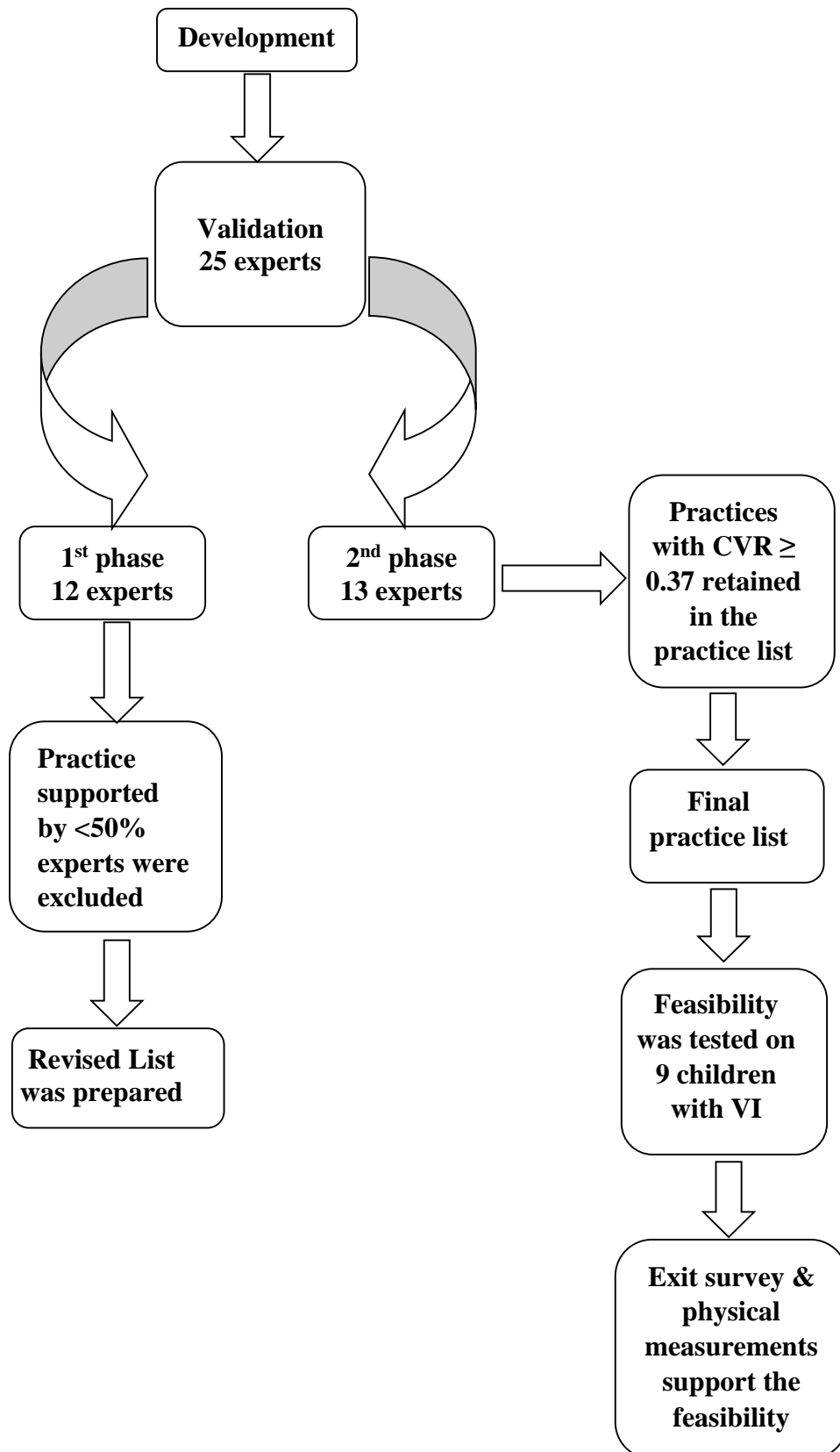


Table 5.4.2: List of Yoga Practices	
Type of Practice	Name of the Practices
Breathing Practices	Hands in and out breathing Ankle stretch breathing Sasankasana breathing Tiger breathing
Loosening Practices	Jogging and Jumping Forward and backward bending Twisting Suryanamaskar (Sun salutation)(12 rounds)
Yogasanas	
Standing-Asanas	Ardha Cakrasana (Half wheel bend pose) Padahastasana (Hand to foot pose) Trikonasana (Triangle pose) Parivritta Trikonasana (Twisted triangle pose)
Sitting-Asanas	Vajrasana (Thunderbolt pose) Paschimottanasana (Back stretching pose) Ustrasana (Camel pose) Vakrasana (Half spinal twist)
Prone- Asanas	Bhujangasana (Cobra pose) Salabhasana (Locust pose) Dhanurasana (Bow pose) Makarasana (Crocodile pose)
Supine-Asanas	Sarvangasana (Shoulder stand pose) Halasana (Plough pose) Matsyasana (Fish pose)
Pranayama	Kapalabhati (Frontal brain cleansing) Vibhagiya pranayama (Sectional breathing) Nadisuddhi pranayama (Alternate nostril breathing) Bhramari pranayama (Humming bee breathing)
Relaxation/ Dharana & Dhyana	Instant, Quick, and Deep Relaxation Techniques/ Nada-anusandhana A+U+M Chanting (each 9 rounds)

5.5 ASSESSMENTS

Assessment sessions were arranged pre and post the intervention for both groups. Participants were assessed on anthropometric measures, physical and psychological parameters described below. (Table 5.5)

Socio-demographic Data (Appendix 3)

A Socio-demographic Data form was prepared, in order to assess socio-demographic data: age, gender, and income level of parents; medical histories were obtained from the school office, and through semi-structured interviews by the SVYASA research team.

Anthropometric Measures

Participants were instructed to wear light clothes and stand with bare feet against a wall. Height was measured to the nearest centimetre using a non-stretchable measuring tape (Gillick Anthropometric tape 60” Model J00305, Lafayette Instrument, U.S.A.). Weight was measured using the In Body R20 Composition Analyzer (from Gym Company) and Body Mass Index (BMI) calculated. For the motor speed test, physical and functional assessment of the upper limb with inspection, palpation and active movement to check the integrity of the musculoskeletal and neuro-functional system was carried out before administration of the test.

5.5.1: Physical parameters

The following tests were given to assess physical fitness, descriptions are given below.

5.5.1.1 Muscle Strength

5.5.1.1.1 Upper Extremity Strength

a) Hand Grip Strength

Instrument- Hand grip strength of both right and left hands was assessed using a hand grip dynamometer (Lafayette Instruments, Model No. J00109, Indiana, USA). It measures strength from 0 to 200 pounds (90 kg).



Data Extraction- The participant was seated with shoulders adducted and neutrally rotated, elbow flexed at 90 deg, wrist between 0 and 30 deg extension, and between 0 and 15 deg ulnar deviations (American Society of Hand Therapists). The handle position of the device was set to the second position for all participants.

Scoring- Participants were tested for six trials, three in each hand alternately, with a gap of 10 seconds between trials; each attempt was scored. The maximum value obtained during the three trials for each hand was recorded for subsequent statistical analysis.

b) Pinch strength

Instrument- Pinch strength was assessed bilaterally, using Jamar hydraulic hand and pinch dynamometers (Lafayette Instruments, Model No. J00109, Indiana, USA).



Data Extraction- Participants were seated in a chair without armrests, feet resting fully on the ground and hips against the back of the chair. The arm remained parallel to the body, shoulder adducted, elbow flexed at 90⁰ and forearm in neutral position, wrist between 0⁰ and 30⁰ of extension and 0⁰ to 15⁰ of ulnar deviation. This position has demonstrated the highest reliability coefficients (MacDermid, Evenhuis, & Louzon, 2001).

Scoring- Three consecutive measurements of each hand (total 6 trials) were performed alternating between the dominant and non-dominant sides, with minimum intervals of 30 secs to avoid muscle fatigue. Maximum value obtained from each set of three trials was recorded for subsequent statistical analysis.

c) Elbow strength

Instrument- Maximum isometric muscle strengths (peak force, in kg) of Elbow Flexion and Elbow Extension were measured bilaterally using the Lafayette Manual Muscle Test System (Lafayette Instruments, Model No. 01165, Indiana, USA).



Data Extraction- Participants were assessed using standardized measurement procedures (Hislop & Montgomery, 2007) and dynamometer placements (Lafayette Manual Muscle Test, 2012).

Scoring- Three consecutive trials were conducted, with 10 seconds rest between trials. Maximum peak force of the three trials was recorded for subsequent analysis.

5.5.1.1.2 Lower Extremity Strength

➤ Knee Strength (KS)

Instrument- Knee Flexion and Knee Extension were measured in both right and left Leg using the Lafayette Manual Muscle Test System (Model 01165), a reliable and valid tool for assessment of isometric lower limb muscle strength and power (Mentiplay et al.,2015).

Data Extraction- Participants were instructed to pull or push against the device as firmly as they can in each direction, as the investigator counteracts that force for 5 seconds per trial. The instrument was recalibrated before each participant was tested.

Scoring- Three consecutive trials were conducted, with a 10 seconds rest between trials. Maximum peak force of the three trials was recorded for subsequent analysis.

5.5.1.1.3 Minimum Muscular Fitness

The Kraus-Weber test (K-W test) is a reliable and easy exercise test (Babalola, Awolola, & Hamzat, 2008) which includes six specific tests to measure strength and flexibility of various different muscle groups. A pass or fail test, a 'fail' on any one of its six test items constitutes a whole-test failure. Those who fail the test appear to be unhealthy, emotionally imbalanced, and/or constantly exhibiting strain (Kraus & Hirschland, 1953).

Data Extraction: The K-W test was conducted as follows:

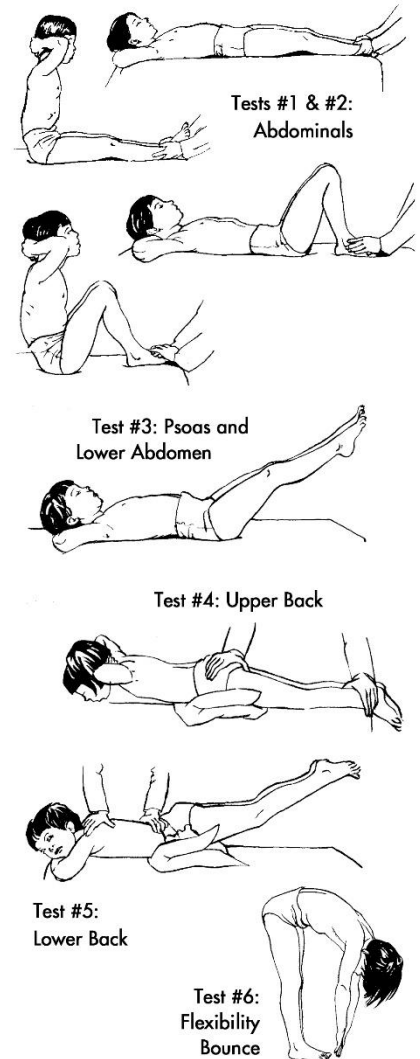
Test 1: participants were instructed to lie flat on their back with hands behind the neck. As the examiner holds their feet on the ground, they are asked to roll up into a sitting position.

Test 2: the body position for this test remained the same, but the knees were bent. Again the feet were held, and they were asked to follow the same procedure as test 1.

Test 3: the position of the body was with legs extended. Students were instructed to lift the feet 25 cm (10 inches) off the ground, and keep them there for ten seconds.

Test 4: participants were instructed to lie on their stomach with a pillow under the lower abdomen, and hands behind the neck. The examiner held the feet down, and asks testees to raise their chest, head and shoulders, and remained in that position for ten seconds.

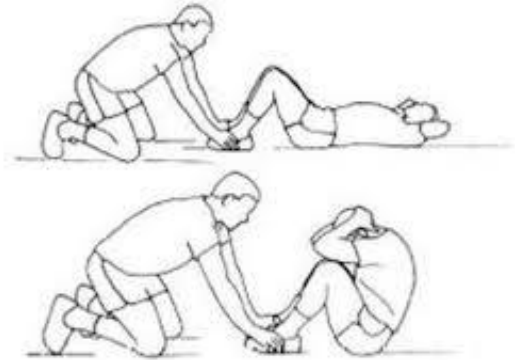
Test 5: (position is the same as test 4) the examiner held the chest down, asking testees to raise their legs without bending at the knees, and to maintain the position for ten seconds.



Test 6: participants were instructed to stand erect with hands by the sides and feet together. They were then asked to lean down slowly with knees straight, and touch the floor with their fingertips. The position was maintained for ten seconds.

5.5.1.2 Muscle Endurance

The Sit-Up Test was used to measure endurance of abdominal and hip-flexor muscles. Participants were instructed to lie on their back with knees bent, hands were kept crossed behind the head and feet flat on the floor held down by the examiner. The number of



complete sit-up cycles (lifting the body into the sitting position and returning to the starting position) performed within the 30 sec duration (stop-watch used) is recorded.

5.5.1.3 Flexibility

Instrument- Flexibility of the lower back and hamstring muscles were measured using the Sit and Reach machine (Lafayette, USA). The apparatus is a box with one side open, the opposite side closed, and a measuring scale on the top.



Data Extraction- The participant sat on the floor with bare feet and was instructed to put the feet flat through the box's open end touching the closed end with knees fully extended. Arms were then extended forward, one hand on top of the other, palms down, on the measuring scale on top of the box, as much as possible. The maximum distance reached with the tips of the fingers by forward flexion of the trunk was measured.

Scoring- Each participant attempted three trials with the maximum reached score being recorded to the nearest centimetre.

5.5.1.4 Hand Coordination

The Plate Tapping Test was used to assess the speed and coordination of hand movement. Two discs were placed with their centres 60 cm apart on a table and a rectangle was placed at their midpoint. The non-preferred hand was placed on the rectangle. Participants were instructed to move their preferred hand back and forth touching the middle of each disc over their stationary hand for 25 cycles (50 taps) as quickly as they can. Score was the time taken in seconds. For those with VI, the normal disc and rectangle were modified to hard cardboard with sandpaper attached to provide participants with strong tactile feedback.



5.5.1.5 Motor Speed

Instrument- The Finger Tapping Test, a neuropsychological test assessing muscle control and motor ability in the upper extremities (Strauss, Sherman, & Spreen, 2006) was used (Lafayette, Model No. 32012, Indiana, USA).



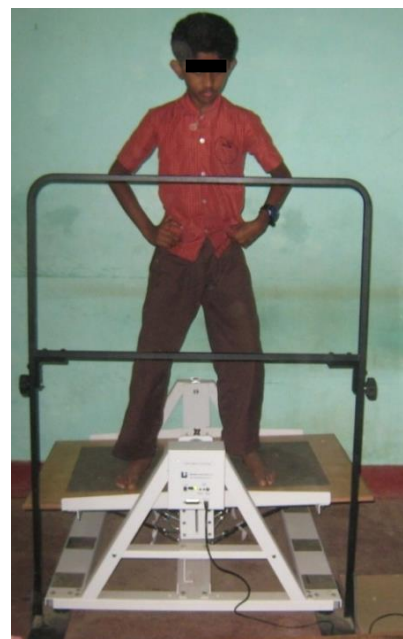
Data Extraction-The instrument was fixed to an adjustable-height table positioned at waist level, and centred on the midline. Participants were instructed to use one hand to hold the stylus as a pen and tap the steel plate using only the index finger, without using the whole hand or wrist. The right index finger was used for the right side of the board, and the left index finger for the left side of the board. After being familiarized with the test with a practice trial, they were instructed to tap as rapidly as possible.

Scoring- The 10 sec for five consecutive trials in each hand alternatively (Strauss et al., 2006). Average score of the 5 trials for each hand were recorded for subsequent analysis.

5.5.1.6 Balance

Instrument- Static and dynamic balance were measured with a stability platform (Lafayette, Model 16030). The stability platform has been found a reliable and valid measure of dynamic balance with an angular resolution of 1° , and range $\pm 30^\circ$ (Murray, Seireg, & Sepic, 1975; Nashner, 1982).

Data Extraction- Static Balance was assessed with 3 test times of 20, 30, and 40 seconds with a 10-second 'rest' time in between. The time spent at $0\pm 1^\circ$ is recorded for analysis. In Dynamic Balance, participants were instructed to tilt the platform from one side to the other, as rapidly as possible, for a time-duration of 10 secs. Each test consists of 3 attempts.



Scoring- When a test was in progress the result was displayed on the screen. As each test cycle ends, data were updated; each trial and the average were displayed.

1.5.1.7 Lung Capacity

Instrument- Peak Expiratory Flow Rate, maximum rate of expiration was measured with a Mini-Wright peak flow meter to measure participants' lung capacity. It was a small hand-held device with a mouthpiece on one end and a scale on the other.

Data Extraction- At rest and in a standing position, each participant blows three times, without a nose clip being used.

Scoring- The highest value of the three trials was recorded for subsequent analysis.



5.5.2 Psychological parameters

The following tests, described below, were administered to assess psychological health.

5.5.2.1 Depression and Anxiety

5.5.2.1A. Child Depression Inventory-2

Rationale / Purpose— The Child Depression Inventory-2 (CDI-2), applying to those aged 7-17 years was used to assess severity of depressive symptoms (Kovacs, 1985).

Description/Content— The test has two domains; emotional problems (mood/physical symptoms, negative self-esteem) and functional problems (ineffectiveness and interpersonal problems). It comprises 28 questions.

Method of Administration/ Data Extraction— Questions from CDI-2 were explained along with options. Assistants administered questions orally to each student and marked replies on the answer sheet. In cases of doubt, the principal investigator clarified the point concerned.

Scoring- For each question the following three responses were allowed: 0 (no symptom), 1 (probable or mild symptom), and 2 (definite, marked symptom). Total Score ranges from 0 to 56, higher scores representing increased severity of depression symptoms.

Reliability and Validity- The questionnaire has a high level of internal consistency (Cronbach's $\alpha = 0.91$), and a high test-retest reliability (0.76-0.92) (Kovacs, 1985).

Examples of use in children with VI—Some previous studies have used this questionnaire to compare levels of depression in adolescents with and without VI (Bolat et al., 2011; Huurre & Aro, 1998). [Appendix 4 (English) and Appendix 5 (Kannada)]

5.5.2.1B. State-Trait Anxiety Inventory for Children

Rationale / Purpose- The State-Trait Anxiety Inventory for Children (STAI-C) was developed by Spielberger to measure the presence and severity of current anxiety symptoms (Spielberger, 1973). It has since been translated and culturally adapted into 48 languages.

Description/Content- The test has 2 subscales: First, the State Anxiety Scale (STAI-S) evaluates the current state of anxiety, asking how respondents feel “right now”. Second, the Trait Anxiety Scale (STAI-T) evaluates relatively stable aspects of “anxiety proneness”. The test has 40 items, 20 for each subscale.

Data Extraction- In this study, research assistants asked participants each item individually and marked their responses on the answer sheet on a scale of 1 to 3.

Scoring- Each item was scored from 1 to 3 based on presence and severity of anxiety symptom. Scoring is reversed for anxiety-absent items (19 of the 40 items). Item scores were added to obtain subtest total scores, ranging from 20–60; higher scores indicate greater anxiety.

Reliability & Validity- Cronbach’s α reliability coefficient is 0.87 for STAI-S present scale and 0.89 for STAI-S absent scale. It is 0.88 for the STAI-T (Kirisici & Clark, 1996).

Examples of use in children with VI- In a previous study of athletes with VI, STAI was presented verbally (Mastro, French, Henschen, & Horvat, 1985). It has also been given in Braille (Bolat, Doğangün, Yavuz, Demir, & Kayaalp, 2011).

Appendix 6 (English) and Appendix 7 (Kannada)]

5.5.2.2 Self-Esteem

➤ Rosenberg Self-Esteem Scale (Appendix 8)

This scale is designed to measure individuals' general levels of self-acceptance, degree of self-satisfaction, or how highly he or she regards him- or herself by measuring both positive and negative feelings about themselves (Rosenberg, 1965).

Description/Contents- The scale comprises 10 questions on a 4 point scale from strongly agree to strongly disagree. 5 questions are based on positive attitude, and 5 on negative.

Data extraction- Research assistants administered questions to each participant who answered them orally, choosing one option; their answers were marked on their answer sheet.

Scoring- The scale is a 10-item Likert scale: the 4-point scale of answers range from strongly agree (score 1) to strongly disagree (score 4): for items 2, 5, 6, 8 and 9 scores are reversed. Total scores range from 10 to 40. Scores below 15 indicate low self-esteem.

Reliability and Validity- Across 53 nations, principal components analysis found the RSES component structure generally invariant. Cronbach's α of 0.81 across nations supports the scale's internal coherence across cultural contexts (Schmitt & Allik, 2005).

Example of Use in Children with VI — Although it contains no item related specifically to VI, an earlier study used the questionnaire to compare levels of self-esteem in adults with VI with those without the disability (Papadopoulos, Montgomery, & Chronopoulou, 2013).

5.5.2.3 Working Memory

➤ N-back Letter Task (Appendix 9)

Purpose- The N-back task is a measure of working memory using simple stimuli and instructions. Many studies of working memory have employed it (Smith & Jonides, 1999).

Description/Content- The N-back task includes two experimental conditions: i) 1-back test, Hit score and Missed score, ii) 2- back test, Hit score and Missed score.

The ‘1 back test’: consists of 31 randomly ordered consonants of Indian language (Hindi). Nine of the 31 consonants are repeated.

The ‘2 back test’: consists of 54 randomly ordered consonants of Indian language (Hindi) 18 of the 54 consonants were repeated.

Data Extraction- 1 back test: The Randomly Ordered Consonants are presented at the rate of one per second. The participant should respond ‘Yes’ whenever a consonant is repeated consecutively, otherwise the response is ‘No’.

2 back test: The Randomly Ordered Consonants are presented at the rate of one per second. The participant responds whenever a consonant was repeated after one intervening consonant.

Scoring- Both tests yield two scores. The first score is called a ‘Hit’, the number of correct responses. The second score is called the ‘misses’, when the participant missed a correct target, saying ‘No’ for a consonant when ‘Yes’ should have been said. Both scores were obtained for the 1 back test, and the 2 back test.

5.5.2.4 Mental wellbeing

➤ General Health Questionnaire (GHQ-28)

Rational/ Purpose— This questionnaire is well-known and popular. It measures the ability to carry out normal activities, and the symptoms of psychological distress (Goldberg & Hillier, 1979).

Discriptions/Content— The questionnaire contains four subscales measuring: Somatic Symptoms, Anxiety and Insomnia, Social Dysfunction, and Depression. 7 items for each subscale: Total 28 items. All items have 4 options.

Data Extraction- Research assistants stated the options and asked participants each GHQ-28 question, marking the answer sheet accordingly. If necessary, they repeated a question until it was completely understood and the participant was able to reply properly.

Scoring- The test uses a binary scoring method (0, 0, 1, 1). The sum of the scores for the four subscales gives the total health score. Lower scores indicate better states of health.

Reliability and validity- The questionnaire has acceptable psychometric properties: good internal consistency, Cronbach's Reliability Coefficient $\alpha = 0.85$; and validity, $r = 0.76$ (Goldberg & Hillier, 1979).

Examples of use in children with VI- The GHQ versions 60 and 12 have been used for students with VI (Bakhla, Sinha, Verma, & Sarkhel, 2011; Bakhla, Verma, Hembram, Praharaj, & Sinha, 2013), but to our knowledge GHQ-28 has not yet used in any such study.

[Appendix 10 (English) and Appendix 11 (Kannada)]

Table 5.5: List of Variables Used in the Study

VARIABLES			INSTRUMENTS/QUESTIONNAIRES
PHYSICAL FITNESS	Muscle Strength	Hand Grip Strength	Jamar hydraulic hand and pinch dynamometers (Lafayette Instruments, Model No. J00109, Indiana, USA)
		Pinch Strength	
		Elbow Strength	Lafayette Manual Muscle Test System (Model 01165)
		Knee Strength	
		Minimum muscular fitness	Kraus Weber Test
	Muscles Endurance		Sit-Up
	Flexibility (hamstrings & lower back)		Sit and Reach Trunk Flexibility Box
	Hand Coordination		Plate Tapping
	Motor Speed		Tapping Board Apparatus (Lafayette Instruments, Model 32012, USA)
	Balance	Static	Stability Platform (Lafayette Instrument, Model 16030, USA)
		Dynamic	
	Lung Capacity		Wright's Mini Peak Flow Meter
PSYCHOLOGICAL HEALTH	Anxiety		State Trait Anxiety Inventory
	Depression		Children's Depression Inventory
	Self-Esteem		Rosenberg Self-Esteem Scale
	Verbal Working Memory		N-Back Test
	Mental Wellbeing		General Health Questionnaire -28 version