4.0 GENERAL

In this thesis the changes in positive health indicators in elderly persons receiving two ancient Indian disciplines (Yoga and Ayurveda) as interventions have been evaluated and described.

4.1 SUBJECTS

4.1.1 General: 120 inmates of a residential home for the aged, over the age of sixty years belonging to both sexes were examined. Thirty of them were ill or bed-ridden. The remaining 90 persons were told about the trial, i.e., that participants would be randomly allocated to: Yoga, Ayurveda or Wait-list control groups. All of them expressed their willingness to participate in the trial and the signed informed consent of each subject was taken. 90 subjects who expressed their willingness to participate in the trial were screened using: the electrocardiogram (all leads), fasting blood glucose, Blood Pressure measurements (using sphygmomanometer), and routine clinical examination.

4.1.2 Source of subjects: The subjects recruited for the study were the inmates of Asaktha Poshaka Sabha (a residential home for the aged), V. V. Puram, Bangalore, South India (see plate I). This residential home does not require the persons residing there to pay any money for their stay and other care including medical checkups and treatment.
4.1.3 **Inclusion criteria:** The subjects who had the following attributes were included in the study: (i) above the age of sixty years; (ii) belonging to both sexes; (iii) residing at the home for the aged for more than 6 months; (iv) healthy on a routine medical examination and on screening and (v) willing to participate in the trial by giving a signed informed consent.

4.1.4 **Exclusion criteria:** Subjects with the following conditions were excluded from the trial: (i) chronic ailments; (ii) disability or immobility; (iii) unwillingness to participate in the trial.

Following the detailed screening and routine clinical examination described above, subjects with the following health problems were excluded from the study: uncontrolled diabetes (seven participants), uncontrolled hypertension (four), neurological disorders (three), dementia (one), hearing impairment (five), and a detected case of non-infective Hansen’s disease. Sixty nine subjects were included for the study after this screening.

4.2 **DESIGN OF THE STUDY**

Subjects were assessed at baseline and after three and six months of their respective interventions (Yoga, Ayurveda, or Wait-list control). See Fig. 4.2.A, B, and C.
Figure 4.2.A: Schematic representation of the design for the Ayurveda group

AYURVEDA

BASELINE  3 MONTHS  6 MONTHS

Figure 4.2.B: Schematic representation of the design for the Yoga group

YOGA

BASELINE  3 MONTHS  6 MONTHS

Figure 4.2.C: Schematic representation of the design for the Wait-list Control group

WAIT-LIST CONTROL

BASELINE  3 MONTHS  6 MONTHS
4.2.1 Randomization: The 69 subjects were stratified according to age [five-year intervals, e.g., between 60 and 65 years (lower limit), and between 90 and 95 years (upper limit)]. Within a particular five-year age range, subjects of each gender separately, were randomized as three groups by the investigator (i.e., Groups 1, 2 and 3) using a standard random number table (Zar, 1999). Allocation of a group to a particular intervention was carried out by the lottery method, as follows: The three interventions ‘Yoga’, ‘Āyurveda’ or ‘Wait-list control’ were written on three similar pieces of paper which were folded. A person who had no other part in the trial, picked up and opened the folded papers. The first intervention to be picked up was assigned to Group 1, and accordingly for Groups 2 and 3. Following stratified sampling and random allocation, there were twenty-three subjects in each group (including seven males in the Yoga group and six males each in Āyurveda and Wait-list control groups) with average ages (± S.D.) of 70.1 ± 8.3, 72.1 ± 9.0, and 72.3 ± 7.4 years, respectively. Further details of each subject such as their duration of stay in the home, reasons for staying in the home, and their general health status were noted and the details are given in Tables 4.2.1.1, 4.2.1.2 and 4.2.1.3 (See Appendix 3).

4.2.2 Ethical considerations: The protocol was approved by the Institutional Ethical Committee (IEC) of Swami Vivekānanda Yoga Research Foundation, Bangalore. The subjects were told about the aims and methods of the study and the informed consent was signed by all subjects (a sample copy is enclosed as Appendix-1). The variables measured in the present study are essentially noninvasive in nature.
4.3 VARIABLES STUDIED

All three groups were assessed at baseline, and after three and six months of their respective interventions (or no intervention in the case of the wait-list control group). In the present study a comprehensive battery of tests was designed which included different variables taken from the standard battery for the short term measurement of the rate of human aging (Comfort, 1969) and which came under three broad categories: (i) General health measures, (ii) Neurological variables and (iii) Psychological variables. The details about the rationale for using individual variables, their usefulness and limitations are given in Table 4.3. The variables studied at three and six months are schematically represented in Fig. 4.3.A and B respectively. Further details (tool used, range of operation, accuracy, units and the probable percentage of error of the tool used) of the first two categories of variables are given in Table 4.3A (See Appendix 7).

It should be noted that in this thesis, the words ‘variable’ and ‘parameter’ have been used synonymously. Since parameters are described as ‘characteristics of distribution or relationships in the population which are estimated by statistical analysis of a sample of observations’, and variables as ‘measurements or attributes on which observations are made (Altman, Gore, Gardner, & Pocock, 1983) as far as possible the correct term has been used.
Fig. 4.3.A: Schematic representation of the variables studied at baseline and after three and six months

Variables studied:

(i) General health measures
   Pulmonary functions
   Grip strength

(ii) Autonomic variable
    Autonomic and respiratory variables
    Wechsler memory scale

(iii) Psychological variables:
     Geriatric depression scale
     Sleep rating questionnaire

Fig. 4.3.B: Schematic representation of the variables studied at baseline and after six months

Variables studied:

(i) General health measures:
    Anthropometric measurements

(ii) Neurological variables:
     Audiometry
     Heart rate variability
     Tinetti balance and gait evaluation
     Timed up and go
4.3.1 General Health Measures

The following variables were studied under this category: (i) Pulmonary functions, (ii) anthropometric measurements, and (iii) hand grip strength.

4.3.1.1 Pulmonary functions were assessed as there exists evidence that the lung functions are deranged due to aging (Medina, 1996). Pulmonary functions were studied using a computerized spirometer (Schiller Spirovit Sp-1, Switzerland) (see plate II). Subjects were asked to sit at ease. Relevant information i.e., name, age, gender, height (cm), and weight (kg) was noted and entered in the spirometer. Before each measurement the subjects were asked to breathe in and out through the mouth for three breaths. A disposable unit of the mouth piece of the spirometer was used. Instructions were given to hold the disposable mouth piece tight between the lips to avoid the leakage of air. A nose clip was used to ensure that they breathed through the mouth. Each subject was given a demonstration about how to breathe during the following measurements:

4.3.1.1A Forced Vital Capacity (FVC): Subjects were asked to take a deep inhalation followed by forceful exhalation. Since the greatest amount of air that can be expired after maximal inspiratory effort gives useful information about the strength of the respiratory muscles and other aspects of the pulmonary functions, it was clinically measured as an index of pulmonary function.

4.3.1.1B Slow Vital Capacity (SVC): Subjects were instructed to breathe normally for three rounds followed by a maximal inhalation and maximal exhalation. SVC also indicates the strength of respiratory muscle though there is no emphasis on speed of exhalation.
4.3.1.1C **Maximum Voluntary Ventilation (MVV):** Subjects were asked to breathe in and out rapidly for one minute (maximal rapid inhalation and exhalation). MVV measures the strength of the respiratory muscle in breathing in and out repeatedly to maximum for 30 seconds.

4.3.1.1D **Minute Ventilation (MV):** Subjects were asked to breathe normally for one minute. Minute Ventilation is a product of the tidal volume and the breath rate.

4.3.1.2 **Anthropometric measurements:** In the present study the following anthropometric measurements were included: (1) Body Mass Index (BMI), (2) Mid arm circumference, and (3) Waist-hip ratio.

4.3.1.2A **Body Mass Index (BMI):** The Body Mass Index or the Quetelet index was calculated from the equation: BMI = weight (kg)/square of the height (m). Body weight was measured with a beam balance accurate up to 100g to a maximum of 120kg, before eating and after voiding. The height was assessed with a measuring scale attached to a wall, perpendicular to the floor. The subjects were barefoot, standing with feet together and with head, shoulders, buttocks and heels touching the wall. The plane of the ear, mid-point of the hip bone and ankle was parallel, i.e., with the subject standing at attention. The height was then read from the measuring scale to the nearest centimeter.

Circumferences are important measurements that record the size of cross-sectional and circumferential dimensions of the body. Circumferences were measured using a measuring tape. The tape measure selected was inelastic (non-stretchable), and 0.7 cm wide. Recordings were made with the zero end of the tape held in the left
hand and the remaining part of the tape held by the right hand. No tension was applied on the tape during measurements (Garrett & Kennedy, 1971).

4.3.1.2B Mid arm circumference: Mid-arm circumference is indicative of muscle mass and subcutaneous fat. The subject was asked to stand erect, with the arms hanging freely at the sides of the trunk and with the palms facing the thighs. To locate the mid point of the upper arm, the subjects’ elbow was flexed to $90^\circ$ with the palm facing upwards. The lateral tip of the acromion was located by palpating laterally along the superior surface of the spinous process of the scapula and the tip of the olecranon process was marked. The tape was placed connecting these two points and the mid point between them was marked. With the arm relaxed and the elbow extended and hanging by the side of the trunk and the palm facing the thigh, the tape was placed around the arm so that it was touching the skin, but not compressing it. The tape was placed perpendicular to the long axis of the arm at the marked mid point, and the circumference was recorded to the nearest centimeter.

4.3.1.2C Waist–hip ratio: The waist-hip circumference ratio is a measure of the distribution of subcutaneous and intra-abdominal fat. The ratio tends to increase with age and excess weight. To measure waist circumference, the subject was asked to stand erect with abdomen relaxed, the arms at the sides and the feet together. The measuring tape was placed around the bare abdomen just above the hip bone at the level of the natural waist which was the narrowest part of the torso. It was made sure that the tape was snug, but was not compressing the skin, and was in a horizontal plane. The subject was asked to relax, and on exhalation the measurement was taken to the nearest centimeter.
To measure hip circumference, the subject was asked to stand erect with arms at the sides and feet together. The measuring tape was placed in a horizontal plane around the buttocks where the circumference was maximum. The tape was in contact with the skin but did not indent it. The measurement was recorded to the nearest centimeter.

4.3.1.2D Hand grip strength: The Hand grip strength measures the muscle endurance during a sustained contraction. Hand grip strength was measured using a grip dynamometer (Anand Agencies, Pune). Subjects were tested in 6 trials, 3 for each hand alternately with 10 seconds gap between trials. During the assessment subjects were asked to keep their arm extended at shoulder level, horizontal to the ground (Raghuraj, Nagarathna, Nagendra, & Telles, 1997) and the maximum value obtained for each trail in Kilograms was recorded.

4.3.2 Neurological Variables

4.3.2.1 Autonomic and respiratory variables: It is now accepted that the autonomic nervous system can be controlled and its responses integrated and modified by the central nervous system. Compared to certain autonomic variables (namely, electrodermal activity and heart rate), respiration is a complex function, which includes striate and smooth muscle activity, ventilation, gas diffusion, pulmonary circulation, gas transport in the blood and mechanisms of breathing. However the autonomic and respiratory variables all commonly used, though their control mechanisms differ in psychophysiological investigation. A 4-channel polygraph
Medicaid Systems, Chandigarh, India) was used to record the electrocardiogram (EKG), respiration, and skin conductance level (see plate III).

4.3.2.1A Skin Conductance Level (SCL): Skin conductance was recorded using Ag/AgCl disc electrodes with electrode gel (Medicon, Madras, India), placed in contact with the volar surfaces of the distal phalanges of the index and middle fingers of the left hand. A low-level DC preamplifier was used and a constant voltage of 0.5V was passed between the electrodes (Medicaid, Chandigarh, India).

4.3.2.1B Breath Rate: Breath rate was recorded using a nasal thermistor clipped on to the more patent nostril. The nasal thermistor was connected to an AC amplifier and recordings were made with sensitivity set as required (Medicaid, Chandigarh, India).

4.3.2.1C Electrocardiogram (EKG): The electrocardiogram was recorded using standard bipolar limb lead I configuration and an AC amplifier with 1.5 Hz high pass filter and 75 Hz low pass filter settings (Medicaid, Chandigarh, India).

4.3.2.1D Heart Rate Variability (HRV): The EKG was digitized using a 12 bit analog-to-digital converter (ADC) at a sampling rate of 500 Hz and stored on the hard disk of a PC (Pentium) for analysis. The R waves were detected to obtain a point event series of successive R-R intervals, from which the beat to beat heart series was computed (See Fig. 4.3.2.1D). The data recorded were visually inspected off-line and only noise free data were included for analysis. The following variables were measured

1. Low frequency (LF) power of HRV spectrum (normalized units)
2. High frequency (HF) power of HRV spectrum (normalized units)
3. Ratio of low and high frequency (LF/HF) powers
Fig. 4.3.2.1D: Heart rate variability spectrum (HRV)

Fast Fourier Transform analysis (FFT): HRV power spectrum
(VLF band = 0.0 - 0.05 Hz, LF band = 0.05 - 0.15 Hz and HF = 0.15 - 0.50 Hz)
4.3.2.2 Evaluation Gait, Balance and Mobility: For the elderly, walking without assistance requires the effective coordination of adequate sensation, musculoskeletal and motor control, and attention. As age advances beyond 70 years, the gait velocity (speed of walking) starts declining about 15 percent per decade for usual gait and 20 percent per decade for maximal gait (Medina, 1996). Balance may be defined in terms of measurable components which are needed to perform daily activities. The antero-posterior sway differences between old and young people increases when visual input or tactile–proprioceptive input is blocked or inaccurate (Wolfson, Whipple, & Derby, 1992). This suggests that in older people processing of sensory information into a postural response requires additional input, i.e., visual or tactile–proprioceptive feedback in addition to vestibular input.

4.3.2.2A The Tinetti balance and gait evaluation test: The Tinetti Balance and Gait test performs standardized evaluation of mobility and stability. Balance and gait are assessed and scored individually in a 16-item test. The Tinetti balance and gait evaluation test required the subject to be seated in a hard chair without arms as support. Different maneuvers related to balance (9 items) and gait (7 items) were tested as per the procedure required to evaluate individual items (Tinetti, 1986). Balance, the variable assessed first, was judged while sitting, arising, standing (immediate and prolonged), and turning. Additionally, maintenance of balance was tested against attempts at disruption (nudge) and without a horizon reference (eyes closed). These indicate body control and strength. In gait testing, right and left feet were evaluated separately for swing (step length) and clearance, and then compared. As per the maneuver each foot should completely clear the floor and should step
completely ahead of the other foot. Comparisons included step symmetry and continuity. Additionally during walking, the path deviation, trunk stability, and stance (normal or wide-based) were also evaluated. A score of 22 or less (total 28) indicated the risk of fall.

The normal gait cycle is presented in Fig. 4.3.2.2A.

Fig. 4.3.2.2A: The normal gait cycle.

4.3.2.2B Timed-up-and-go test: The timed up and go test measures basic mobility skills including a sequence of functional maneuvers used in everyday life. Subjects were asked to sit in a hard chair without arms for support. They were asked to get up from the chair and walk along a straight line for a distance of 5 meters at their usual pace and return to the sitting position. The time taken to get up from the chair, walk and return to the original position and the number of steps taken for the task were noted (Podsiadlo, & Richardson, 1991). The procedure of the test has been schematically represented in Fig. 4.3.2.2B

Fig. 4.3.2.2B: Schematic representation of the Timed-up-and-go test
4.3.2.3 **Wechsler Memory Scale:** Age related changes are seen in two brain areas associated with memory i.e., (i) The frontal lobe which controls certain executive memory processes and (ii) hippocampus leading to the deterioration of explicit memory capacities. Also, studies have shown that both short term and long term memories change as one gets older. Most of the problems are caused not by an irreversible loss of a specific fact, but from impaired retrieval mechanisms (Medina, 1996).

In the present study, the following components of memory were tested using the Wechsler memory scale i.e., (i) long-term memory and orientation, (ii) mental control, (iii) attention and concentration (digit span forward and backward), and (iv) associate learning. Assessments were made individually. Subjects were seated at ease. The answers were recorded on a separate sheet for each subject. Since the questionnaire was already evaluated for reliability and validity for Indian geriatric population the standardized English version of the questionnaire was administered in the present study.

4.3.2.4 **Audiometry:** The auditory acuity of the subjects was measured using a computerized audiometer (Elkon Private Ltd., Mumbai; model – EDA 3N3 PLUS) (see plate II). This provided an objective measurement of the degree of deafness and of the tonal range most affected. Subjects were asked to sit in a sound dampened room. The audiometer was used to present subjects with pure tones of various frequencies through acoustically shielded ear phones. At different frequencies
(ranging between 500 Hz and 12 KHz), the threshold intensity was determined and plotted on a graph as a percentage of normal hearing (Ganong, 1987).

To standardize the recording procedure and to eliminate probable differences in the frequencies heard at the testing site and a conventional speech and hearing laboratory, recordings were made first in an acoustically shielded cabin at the Richmond Clinic for Speech and Hearing, Bangalore. The same subject was then assessed in the laboratory where the study was being conducted and the hearing frequencies were compared. They were found to be comparable. Hence subsequent recordings were done at the recording site.

Subjects were assessed for the hearing threshold at the following different frequencies: (a) Low frequency (500Hz and 1.0 KHz) and (b) High frequency (6.0 KHz, 8.0 KHz and 12 KHz). The hearing threshold for each ear was determined by giving monaural tone stimuli through close fitting acoustically shielded earphones. For each frequency the intensity was raised from 10 dB to 100 dB with an increment of 10dB each time. Subjects were given a remote controlled button to press when they heard tones at different frequencies. The highest intensity detected by a subject was recorded as threshold intensity. False signaling was detected by doing the trial in the descending order.
4.3.3 Psychological Variables

4.3.3.1 Geriatric Depression Scale: As the population of people over the age of 65 years increases, more cases of late-life depression are likely to occur though depression is not a natural part of aging (Nelson, 2001). The depression symptom scores of all three groups were assessed using the short version of the Geriatric Depression Scale (GDS-S) (Sheikh, Yesavage, Raret, & Lum, 1986). This easily administered, self-report inventory is a basic screening measure for depression in older adults. It consists of 15 questions to determine how subjects felt over the past week. Each item is presented in a dichotomous format. The score range was between 0 to 15, with 0 = no depressive symptoms. Based on the scores, subjects could be classified into three categories i.e., (1) scores between 0-5 as normal, (2) 6-10 as mildly depressed and (3) 11-15 as severely depressed. The questionnaire was administered individually at baseline, and after three and six months of the interventions (Yoga, Ayurveda, or Wait-list control).

Reliability and Validity of GDS-S: The original version of the geriatric depression scale (GDS) has 30 items (Segal, Coolidge, & Hersen, 1998). The short version of the GDS (which has 15 items) was evaluated for validity (De Graen, Heeren, & Gussekloo, 2003) and was shown to detect longitudinal changes in symptoms of depression (Vinkers, Gussekloo, Stek, Westendorp, & Van der Mast, 2004). Also, long detailed interviews and testing batteries are not tolerated well by many older people due to fatigue (Segal et al., 1998). Hence the short version of the GDS was preferred for use in the present study. The GDS-S has been used to assess depression in older people with normal health (T’Sjoen et al., 2005). However one report
mentioned that in ‘old-old’ people (as mentioned in the paper) (i.e, those over the age of 75 years) the GDS-S has a 60 percent sensitivity to detect major depression (as was seen in the present study) in healthy older people (Watson, Lewis, Kistler, Amick, & Boustani, 2004).

With regard to the use of GDS in an Indian population, the GDS (short version) as used in the present study, was administered in 1554, mostly illiterate people over the age of 55 years in northern India who were Hindi-speaking (Ganguli et al., 1999). The scale which was developed was called the GDS-H, i.e., geriatric depression scale – Hindi version. The GDS-H had high internal consistency and the factor structure was comparable to that of the original version in English. This Hindi version was considered suitably reliable and valid. In the present study, it was not considered necessary to use the GDS-H, as the group of community dwelling older people who participated in the study were all literate and were able to understand spoken and written English. This was first verified in all subjects before administering the questionnaire, which was possible as the questionnaire was administered on an individual basis.

4.3.3.2 Sleep Rating Questionnaire: Sleep in older persons is characterized by decreased ability to stay asleep, resulting in fragmented sleep and a decrease in daytime alertness (Bliwise, 1992). In the present sleep rating questionnaire there were seven questions, which subjects were asked to answer based on their experience during the week prior to assessment. Asking them to recall their quality and amount of sleep in the week prior to assessment was important, as recall over longer periods
is especially likely to be influenced by anamnesis in older persons (Kayed, 1995). The questionnaire consisted of seven questions. The questions were either dichotomous [i.e., two options: yes/no; Questions 5 and 6] or open questions [i.e., Questions 1, 2, 3, 4 and 7].

The questions were:

1. Approximately how long (in minutes) does it take you to fall asleep?
2. How many hours do you sleep each night?
3. How many times (if any) do you wake up during the night?
4. What are the usual reasons for waking up, if you do so?
5. Do you feel rested in the morning (yes/no)?
6. Do you sleep in the daytime (yes/no)?
7. If your answer to Question 6 was ‘yes’, for how long do your daytime naps last (in minutes)?

**Reliability and Validity:** The sleep rating questionnaire has been evaluated for its reliability and validity based on standard criteria. Reliability was ascertained based on (i) temporal stability and (ii) internal consistency (Singh, 2002). To assess temporal stability the correlation coefficients were calculated using the data of the ‘no intervention’, Wait-list control group with two correlations being made, viz.: (i) baseline with three months and (ii) baseline with six months. Out of the five variables for which the correlations were made the temporal stability was demonstrated for four. In order to evaluate internal consistency the correlation between two variables, which assessed an equivalent aspect of sleep, was calculated. The two variables were the number of hours slept each night and the
feeling of being rested in the morning. The values for the three groups were as follows: Yoga (r = .643), Ayurveda (r = .578) and Wait-list control (r = .699). Validity was inferred based on the content and indirectly based on the test for internal consistency described above.
4.4 DATA EXTRACTION

4.4.1 General Health Measures:

4.4.1.1 Pulmonary Function Tests (PFT): The following values were obtained as a computer printout from the computerized spirometer, i.e., (i) forced vital capacity (FVC), (ii) slow vital capacity (SVC), (iii) maximum voluntary ventilation (MVV), and (iv) expired or minute ventilation (MV).

4.4.1.2 Anthropometric measurements:

4.4.1.2A Body Mass Index (BMI): The Body Mass Index or the Quetelet index was calculated from the equation, BMI = weight in kg/(height in meters) (Altman, Gore, Gardner, & Pocock, 1983).

4.4.1.2B Mid arm circumference: The mid arm circumference was recorded directly in centimeters.

4.4.1.2C The waist-hip ratio was derived from the formula: waist circumference in centimeters/ hip circumference in centimeters.

4.4.1.3 Hand grip strength: Subjects were tested in 6 trials, 3 for each hand alternately with 10 seconds gap between trials. The average of the three values (in Kilograms) for each hand was considered for further analysis.
4.4.2 Neurological Variables

4.4.2.1 Autonomic and respiratory variables:

4.4.2.1A Skin Conductance Level (SCL): The skin conductance level (SCL in micro Siemens) was sampled at 20-second intervals. For each subject, the average of the values obtained during the 5-minute session was used for analysis.

4.4.2.1B Respiratory Rate: The respiratory rate (in breath cycles/ minute) was counted for successive 60 seconds epochs. The readings were averaged for the 5 minute block period.

4.4.2.1C Heart Rate: The heart rate (beats/ minute) was obtained by counting the R waves of the QRS complex in successive epochs of 60 seconds and averaged for the 5 minute block period.

4.4.2.1D Heart Rate Variability (HRV): The HRV power spectrum was obtained using fast Fourier transform analysis (FFT). The power in the HRV series of the following specific bands was studied, viz., the very low frequency component (0.0 - 0.05 Hz), low frequency component (0.05 - 0.15 Hz), and high frequency component (0.15 - 0.50 Hz). The low frequency and high frequency values were expressed as normalized units, which represent the relative of each power component in proportion to the total power minus VLF component [LF norm = LF / (total power-VLF) × 100; HF norm = HF / (total power – VLF) ×100)] (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996).

The values were obtained directly using the HRV analysis software (Ramakrishnan, Srinivasan, & Fetzer, 1993).
4.4.2.2 Balance, Gait and Mobility

4.4.2.2A The Tinetti gait and balance scale: The items were scored “0”, “1”, “2”. The total for balance and gait was calculated separately. Also, the balance and gait values were added together to obtain the total score. Points were lost to varying degrees for requiring assistance, using an aid (cane, walker, furniture), multiple attempts, staggering, asymmetry, sway, and deviation.

4.4.2.2B The Timed-up-and-go test: The two main aspects, viz. the time taken to get up from the chair, walk and return to the original position and the number of steps taken for the task were used for further analysis.

4.4.2.3 Wechsler memory scale: The components which were tested were: (a) long-term memory (comprising of 5 questions and each correct answer was scored as “1”). (b) orientation (having 5 questions and each correct answer was scored as “1”), (c) mental control [(i) counting digits forward and backwards i.e., 1 to 10 and back to 1, (ii) counting by two (e.g., 2+2=4, 4+2=6, till 20) and alphabets (A to Z). The time taken for completing above mentioned tasks, and the number of errors were noted separately and analyzed. (d) digit span forward and backward (each correct answer scored as 1, the sum of all correct answers for digit span forward and backward were recorded separately), and (e) associate learning (each easy answer was scored as “1” and difficult answer as “2”).

4.4.2.4 Audiometry: The threshold intensities (in dB) were obtained as a computer printout from the computerized audiometer for right and left ears separately after
measuring the hearing threshold at the following different frequencies: (i) low frequency (500 Hz and 1.0 KHz) and (ii) high frequency (6.0 KHz, 8.0 KHz and 12 KHz).

4.4.3 Psychological Variables

4.4.3.1 Geriatric Depression Scale: The questionnaire consisted of 15 dichotomous questions [i.e., with two options: Yes/No]. If the answer was ‘No’ to the questions 1, 5, 7, 11, and 13 and ‘yes’ to the remaining questions was scored as “1”, otherwise scored as 0.

4.4.3.2 Sleep Rating Questionnaire: This questionnaire consisted of seven questions. The questions were either dichotomous [i.e., two options: yes/no; Questions 5 and 6] or open ended questions [i.e., Questions 1, 2, 3, 4 and 7]. The dichotomous questions were scored as follows: if the answer was ‘yes’ scored as ‘1’ and ‘no’ scored as ‘0’. Open ended questions with numerical values as answers (e.g., How many hours do you sleep each night?) were used directly for further analysis.
4.5 DATA ANALYSIS

Data were analyzed using the statistical package (SPSS Version 10.0). The data of baseline, three and six months of all three groups were assessed with tests for normality distribution using both graphical presentations (box plot and histogram) as well as Kolmogorov-Smirnov test. A one way analysis of variance (ANOVA) was used to compare the data of the three groups at baseline.

Repeated measures ANOVA is one in which multiple measurements on the same experimental subjects comprise the replicate data (Kepner & Robinson, 1988). In the present study, the repeated measures ANOVA was used for data analysis since there was a consequential relationship among the within subjects data (Zar, 1999). Hence, the repeated measures ANOVA was used to test for (i) significant differences between the assessments i.e., at baseline, three and six months (this was a Within-Subjects factor; Time) and (ii) differences between the groups (Āyurveda, Yoga and Wait-list control), this was a Between-Subjects factor, and the test for a Time by Group interaction provided a global test for an intervention effect.

The t-test for paired data was used to compare data at three and six months with those at baseline of each group, separately. These parametric tests were used even though the data were found to be not normally distributed as it has been shown that analyses of variance and t-tests are usually robust enough to perform well even if the data deviate somewhat from the requirements of normality and homoscedasticity (Zar, 1999).

The Wilcoxon paired signed ranks test was used as a non-parametric statistical test to compare data at three and six months with those at baseline of each group,
separately. When the data were binary (i.e., ‘0’ or ‘1’), another non parametric statistical test i.e., McNemar test was used to compare data at three and six months with those at baseline of each group, separately.
4.6 INTERVENTIONS

4.6.1 Yoga training: Yoga is an ancient Indian science and way of life which brings about relaxation and also induces a balanced mental state (Taimini, 1986). Yoga techniques include physical postures (āsanās), voluntarily regulated breathing (prāṇāyamās), meditation, and philosophical principles which help to reach a balanced mental state.

The Yoga session was planned to include: physical activity, relaxation, regulated breathing and philosophical aspects of yoga. This was an integrated approach of yoga, derived from principles in ancient yoga texts which emphasize that yoga should promote health at all levels (Gambhirananda, 2002). This combination is believed to promote physical health (physical postures, loosening exercises and relaxation techniques), normal functioning at the subtle energy level (breathing exercises, voluntarily regulated breathing), mental and emotional level (meditation and devotional sessions) and at the intellectual level (lectures on philosophy of Yoga) (Nagendra & Nagarathna, 1985). This is because Yoga practices are meant to act at all levels of functioning to promote an overall wellbeing. Also, the present study evaluated different functions which are modified by the aging process. These range from general health measures to neurological and psychological variables. Hence the diverse Yoga practices were expected to be influencing different aspects of functioning. As the program was an integrated one, the cumulative effects were considered interesting and there was no interest to study the effects of individual practices, separately.
The session was for sixty minutes daily, for six days a week. Subjects practiced breathing exercises (10 min), loosening exercises (śīlākaraṇa vyāyāma, 5 min), physical postures (āsanās, 20 min), voluntarily regulated breathing (praṇāyāma, 10 min) and yoga-based guided relaxation (15 min), which has been described elsewhere (Vempati & Telles, 2002). There was an additional session in the evening which consisted of devotional songs (bhajans, 15 min) and lectures on theory and philosophy of Yoga alternating with ‘cyclic meditation’. The last technique is derived from another ancient Indian text (the māṇḍūkyopaniṣad) and involves alternating cycles of physical postures and supine rest (Telles, Reddy, & Nagendra, 2000).

(See plate IV for Yoga practice session at the home for aged. The Yoga module developed for the geriatric population is detailed in Appendix 10).

3.6.2 Āyurveda: A closely related ancient Indian discipline, Āyurveda (= the ‘Science of Life’, in Sanskrit), provides comprehensive knowledge about diverse aspects of health (Sharma & Dash, 1998). Wide ranges of health measures are covered including massage and herbal preparations. The latter are used for healthy persons (‘rejuvenating preparations’ or rasāyanās) and for therapy. Suṣrutha defines rasāyana as a measure, which prolongs life and provides positive health, improves mental faculties and provides resistance and immunity against diseases (Shastry, 1997). Charaka states that the means of obtaining optimum nourishment to the dhātus is called rasāyana (Sharangadhara, 1985). The present study evaluated the effects of
an āyurveda herbal preparation i.e., a ‘rejuvenating tonic’ (Rasayana Kalpa in Sanskrit) on the positive health indicators of persons aged above sixty years.

**The method of preparation:** 50g of *Emblica officinalis* (fresh fruit), 12.5g of *Sida cordifolia* (coarse powder of the root), 12.5g of *Terminalia arjuna* (fine powder of the dry fruit), were heated with 500ml of water to boiling point and allowed to boil for 15 minutes. The mixture of *Sida cordifolia* and *Terminalia arjuna* was kept aside while the *Emblica officinalis* fruits were removed, mashed, seeded, sieved in a muslin cloth to drain water and then heated with 50g of clarified butter for 5 min. 200g of sugar was added to the mixture of *Sida cordifolia* and *Terminalia arjuna*, mentioned above. This mixture and the *Emblica officinalis* were mixed together. Finally 100g of *Withania Somnifera* (fine powder of the root) and 25g *Piper longum* (fine powder) were added and once the preparation reached room temperature 100g of honey was added. Separate batches of 500g of the preparation were made as and when they were required. (See plate V)

10g of this preparation consisted of the following herbs (the Sanskrit names are given in parenthesis): *Withania Somnifera* (ashwagandha roots, 2g), *Emblica officinalis* (amalaki, 1g), *Sida Cordifolia* (bala, 0.25g), *Terminalia Arjuna* (arjuna, 0.25g), *Piper Longum* (pippali, 0.5g). The other contents were: sugar (4g), honey (2g), water and clarified butter (ghee) in the amount required to get the correct semi-solid consistency. The participants were given 10g (1 tablespoon, approximately) twice a day, once in the morning (6 a.m.) and again in the evening (6 p.m.) for 24 weeks. After both doses they were asked to drink 200ml of skimmed milk, as is prescribed in Ayurveda texts (Sharma & Dash, 1998).
The dose (i.e., 10g twice a day) was decided in consultation with experts from a local Ayurveda medical college and from the Ministry of Health and Family Welfare, Government of India. The dose customarily prescribed for people of all ages is 48g per day, though this may be varied based on the health status and ‘personality type’ (according to Ayurveda) of the individual (Sharangadhara, 1985). The herbal preparation was prepared by an expert in Ayurveda (i.e., a person who had undergone 10 years of pre- and doctoral training in Ayurveda). Regarding the quality control, Ayurveda preparations which are manufactured for sale are required to fulfill norms prescribed by the Drug Licensing Authority, Government of India. In the case of the study preparation (which was made especially for the participants) it was not possible to use the same method of testing. However the Ayurveda expert verified (based on her experience and Ayurveda texts (Hiremath, 2000)) that the constituents were unadulterated and that the method of preparation of the compound was correct. The preparation was given to the participants by a volunteer in the home who had no other part in the trial.

3.6.3 The Wait-list Control group: The Wait-list Control group was not given any intervention but was told that they could receive either Yoga or Ayurveda after the trial. They were asked to continue with the normal routine of the home.

3.6.4 Treatment Fidelity: The treatment fidelity was ensured as follows: To begin with all the participants had agreed to receive whichever treatment was allotted to them, and this was one of the criteria for them to be included in the trial. Apart from this Yoga was practiced in a group. The intervention leader was a trained yoga
instructor who had no other part in the trial. The yoga instructor monitored the residents’ attendance for the sessions, as well as the correctness of their practice and their involvement in it. The Ayurveda group was given the herbal preparation in another room. Their participation in the program was also monitored and their treatment fidelity was also checked. During the rest of the day there was no chance for participants of one group to practice or receive the program of another group.
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Variable Studied</th>
<th>Rationale</th>
<th>Usefulness</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>General Health Measures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Pulmonary Functions</td>
<td>Aging is associated with deterioration of pulmonary functions and this a part of the standard test battery</td>
<td>Progress in aging related changes and the efficacy of specific interventions</td>
<td>Subjects need to understand the instructions to perform optimally.</td>
</tr>
<tr>
<td>1.2</td>
<td>Anthropometric Measurements</td>
<td>Age associated changes in body weight and fat distribution are well documented</td>
<td>The changes associated with fat distribution are associated with specific illnesses</td>
<td>Further objective measurements are required to substantiate these findings</td>
</tr>
<tr>
<td>1.3</td>
<td>Hand Grip Strength</td>
<td>Muscle strength decreases with age</td>
<td>Muscle endurance of the flexors of the hand can be determined</td>
<td>Subjects need to perform maximally</td>
</tr>
<tr>
<td>2.</td>
<td>Neurological Measurements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Autonomic and respiratory variable</td>
<td>Aging is associated with increased sympathetic activity</td>
<td>Understand Autonomic Nervous System (ANS) functions following an intervention</td>
<td>ANS activity was recorded not Autonomic Function Tests due to the large number of variables and time required</td>
</tr>
<tr>
<td>2.2</td>
<td>Balance, Gait and Mobility</td>
<td>Falls and decreased mobility are the major contributing factors for morbidity in the elderly</td>
<td>Measures the balance, gait and mobility while performing a required daily function</td>
<td>The tests require the observer to be accurate and attentive</td>
</tr>
</tbody>
</table>
### 2.3 Memory

| Memory deficits beyond the age of 60 years is well recognized | The test battery used evaluates long-term memory and orientation, mental control, attention and concentration (digit span forward and backward) and associate learning. | Subjects need to co-operate with the tester |

### 2.4 Audiometry

| Hearing deficits (high frequency) in the elderly is well documented | Influence of an intervention can be studied | Subjects participation with alertness is mandatory |

### 3. Psychological Variables

<table>
<thead>
<tr>
<th>Geriatric Depression Scale – Short version (GDS – S)</th>
<th>Aging is associated with depression though its not an inevitable consequence</th>
<th>The short version of the GDS has been shown to detect longitudinal changes in symptoms of depression. Also, long detailed interviews and testing batteries are not tolerated well by many older people due to fatigue</th>
<th>The GDS – S is a dichotomous scale which does not allow for in-between responses other than Yes/No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep Rating Questionnaire (SRQ)</td>
<td>Sleep in older persons is characterized by decreased ability to stay asleep, resulting in fragmented sleep and a decrease in daytime alertness</td>
<td>The Sleep Rating Questionnaire is a brief questionnaire which gives information about all aspects (both quality and quantity) of sleep for the preceding week</td>
<td>SRQ is subjective in nature. Recall over longer periods is especially likely to be influenced by anamnesis in older persons</td>
</tr>
</tbody>
</table>