Background and Objective: This paper concerns mechanisms responsible for the efficacy of yoga medicine, traditionally attributed to the enlivenment of prana. Our strategy was to investigate levels of Qi in acupuncture meridians, since Qi is usually considered equivalent to prana.

Materials and Methods: Electrodermal measurements at acumeridian endpoints (Tsing points) were made on 32 healthy individuals, pre and post 3 weeks yoga lifestyle program using AcuGraph 3 (an instrument in wide use). A previous study found that inherent errors prevent AcuGraph from precisely evaluating Qi energies in single meridians, so group results are reported: (a) Energy levels, (b) energy stability, and (c) energy balance between (i) Yin/Yang meridians, (ii) upper and lower, and (iii) left and right regions of the body.

Results: Significant improvements were observed in all but energy stability, supporting the ideas that yoga enlivens prana, and that balance in meridians constitutes health. For balance variables, the study observed shifts toward normal at both ends of variable distributions, reducing standard deviations: post-intervention percentages of subjects with values in the ‘healthy’ range increased.

Conclusion: Yoga improved regulation of Qi levels in acumeridian meridians as well as increasing them.

Key words: Prana; yoga; acumeridians; balance.
are such that reliability can only be attributed to group averages and not to individual readings. For that reason, this paper only reports analyses of means and SD’s for the entire experimental group.

Traditionally, there are said to be 72,000 nadis supplying vital energy to every cell in the body. ISM particularly name three nadis in the spine, said to be the main nadis in the whole body: the Ida on the right, the Pingala on the left, and the Sushumna in the centre.\(^{[9]}\) The Ida controls aspects of the body related to the moon, the Pingala controls aspects related to the sun, while the Sushumma functions best when the two are fully enlivened and in balance. This system was widely recognized in ancient times, giving rise to the snake symbols found even today throughout India. The well-known symbol for balanced spinal energies consists of two snakes intertwined round a central column represents perfect health, and is still widely used and worshipped. In western systems, it is called the Caduceus, and was the symbol of health for the system of medicine propagated by Hippocrates—the ‘Hippocratic symbol’.

In relating ISM to Traditional Chinese Medicine, it is tempting to hypothesize the equivalence of Yin and Yang Qi with energies in the Ida as feminine and Pingala as masculine, respectively. This hypothesis will be treated in a later paper.\(^{[10]}\) Balancing Yin and Yang energies is one of the main means of maintaining health.\(^{[11]}\) Acupuncture thus deals with maintaining the equilibrium of ‘Qi’. Sometimes the Moon is said to connect more to the mind, while the Sun is said to connect more to the body. Traditional Indian and Chinese systems thus treat body and mind implicitly in an integrated fashion when restoring a patient to normal health.

In the Siddha system of medicine,\(^{[12]}\) many more individual nadis are named, including the left and right pairs connected to 12 major organs referred to earlier. The Indian and Chinese systems thus seem to be in correspondence. It is therefore pertinent to take machines developed to measure energies in acupuncture meridians, and see if the changes they measure correspond to predicted changes in prana/shakti levels in Indian systems of medicine.

One such machine is AcuGraph 3.\(^{[11]}\) developed to make specific skin-resistance measurements at the final acupuncture points (Tsing points) of the 24 acupuncture meridians. Supposedly, AcuGraph can measure the energy level in each meridian, but previous research suggests that its measurements are better used to assess changes in groups of subjects.\(^{[12,13]}\) The study reported here therefore took a group of subjects, made a fundamental hypothesis about the prana concept used in Yoga, and attempted to verify it by measuring acupuncture meridian energies using AcuGraph 3. Such a study has a two-fold purpose: first to test whether predicted changes can be observed, and second to see whether the hypothesized translation between Indian and Chinese systems holds good. The design of the experiment is given in the ‘Methods’ section below, with results, discussion, and conclusions thereafter.

**MATERIALS AND METHODS**

Subjects: 35 healthy volunteers of both sexes (17 m, 18 f) attending a Yoga Instructor Course (YIC) at the rural campus of Swami Vivekananda Yoga Anusandhana Samsthan (SVYASA), Yoga University, Bangalore, Karnataka, India. Of these, post course readings were obtained from 33.

**Inclusion criteria**

For inclusion in the study, subjects had to be: participating in the YIC; willing to volunteer for the trial; between 18 and 50 years old; completed 12 years education to the end of High School; and able to understand instructions given in English.

**Exclusion criteria**

Presence of cognitive, psychiatric or neurological disorders, or possessing other physical disabilities and for ladies: pregnancy, or menstruation on days of measurement.

**Yoga intervention**

This consisted of the 3-week YIC, an intense yoga lifestyle program, incorporating the following: specified times of rising (4.30 am) and going to bed (9.00 pm), vegetarian diet, singing (\textit{bhajans}), and theory lectures; specific yoga practices, including a graded course in \textit{yogasanas} (yoga postures), \textit{pranayamas} (breathing techniques), \textit{yogakriyas} (purification practices) and yogic games; IAYT specific relaxation and stress management techniques, including various meditation practices [Table 1].

**Assessments**

Assessments were made using the AcuGraph “Digital Meridian Imaging” System, a computerized tool used to measure and analyze energy levels of acupuncture meridians. AcuGraph is a computerized device used to test galvanic skin response at points on traditional acupuncture meridians, and so assess meridian stress.

**Procedure for AcuGraph measurements**\(^{[11]}\)

Subjects sit easily on a chair, with feet on a mat, rather than the floor. A damp cotton ball is used to improve the conductivity of a small, circular, electrical probe, which is then applied to each acupuncture ‘Tsing’ point at the extremities of acupuncture meridians on the hands and
feet, in the order specified by the computer, while an iron ‘ground bar’ is held in the hand on the opposite side. The computer records readings at the specified left and right measuring points on all major acupuncture meridians; 6 on each hand 6 on each foot, corresponding to the left and right meridians for the 12 major organs in the body: lung, pericardium, heart, small intestine, triple warmer, large intestine, liver, spleen, kidney, bladder, gallbladder, and stomach. An excellent pictorial account has been given.\textsuperscript{[13]} 

### RESULTS

Inspection of the data revealed five subjects for whom readings were exceptionally high, with several pre or post readings being over 190 or reaching the maximum limit of 200. This is generally due to excessive moisture on the skin. Previous observations\textsuperscript{[9]} have noted that such subjects have difficulty slowing down and relaxing, and may be considered hyperactive. Because of this fundamental difference between these subjects and others in the study, they were analyzed in a separate group.

Tables 2a and 2b therefore present results for the two groups of 28 and 5 subjects, separately: group averages for important overall combinations of meridians indicating overall energy level (EL), energy stability (ES), personal integrated energy (PIE), and balance between Yin meridians and Yang meridians (Yin-Yang balance), those on the hands and feet (upper-lower balance), and those on left and right sides of the body (left-right balance).

Table 1a shows that, as hypothesized, the overall Qi (prana) energy, EL, was significantly increased, $P < 0.047$, but that energy stability did not change significantly $P > 0.05$. However for changes in energy balance between Upper and Lower meridians and between left and right meridians, there were significant effects: a considerable decrease in standard deviation, indicating a narrowing of the range of the variable. Values of Mean ± 2 SD’s for the post data were between the same values for the pre-data, showing that the distribution 95% confidence intervals had greatly improved.

One way to see this in more detail is to analyze correlations between the pre-post difference in the variable and the initial values of the same variable [Tables 3a, 3b]. The very significant negative ‘r’ values indicate that high initial values decrease, whereas low initial values increase – a narrowing of the distribution, as shown by the observed

### Table 1: Components of a 3-week intensive yoga module

| Component Type                                              | Description                                                                 |
|--------------------------------------------------------------|-----------------------------------------------------------------------------|
| Yogasanas (yoga postures)                                   | Suryanamaskara, tadasana, ardhabhujapadangustasana, vajrasana, virabhadrasana, ustrasana, padmasana, matsyasana, ardhamatsyendrasana, bhujangasana, shalabhasana, dhanurasana, chakrasana, padahastasana, shavasana etc. |
| Yoga pranayamas (breathing techniques)                      | Dog, rabbit, tiger breathing exercises, bhashrika, bhrumari nadi shuddhi, anulomaviloma pranayamas |
| Yogakriyas (purification practices)                         | Kapalabhati, jala and sutra neti, nauli, vamana dhouti, laghu shankaprakshalan |
| Yogic games                                                 | Egg and spoon race, leader-leader change, ramshyam                          |
| IAYT specific relaxation techniques                        | Instant relaxation technique (IRT), Quick relaxation technique (QRT), Deep relaxation technique (DRT) |
| IAYT specific stress management techniques                 | Self management of excess tension (SMET)                                    |
| Various IAYT Meditation practices                          | Omkara meditation, Cyclic meditation                                        |

### Table 2a: Results of AcuGraph pre and post tests on variable averages for 28 normal subjects

| Variable                  | Pre (M±SD)   | Mean±2SDs | Post (M±SD) | Mean±2SDs | Pre/post difference | ES       | Pie       | Yin/Yang | Upper/lower | Left/right |
|---------------------------|--------------|-----------|-------------|-----------|--------------------|----------|-----------|----------|-------------|------------|
| EL                        | 60.61±18.40  | 97.4±23.8 | 87.82±22.62 | 132.9±43.7 | +27.2              | 67.64±12.87 | 95.3±15.83 | 8.00±6.69 | 25.79±16.06 | 9.32±6.57  |
| ES                        | 59.11±15.83  | 90.8±28.4 | 50.07±17.78 | 85.6±14.5  | +6.6               | 59.0±28.4  | 12.75±9.26 | 31.3±0.0 | 48.7±0.00  | 18.6±0.00  |
| Pie                       | 8.00±6.69    | 21.4±0.0  | 12.75±9.26  | 31.3±0.0  |                  | 57.9±0.0  | 23.0±9.5   | 48.7±0.00 | 18.6±0.00  |
| ES change                 |              | +0.09     |             |            |                    |          |           |          |             |            |
| t / P values              |              |          |             |            |                    |          |           |          |             |            |
| SD change                 |              | +0.22     |             |            |                    |          | 1.95±1.95  | 2.57±0.87 | -2.3±2.97  | +0.09      |

### Table 2b: Results of AcuGraph pre and post tests on variable averages for 5 hyperactive subjects

| Variable                  | Pre (M±SD)   | Mean±2SDs | Post (M±SD) | Mean±2SDs | Pre/post difference | ES       | Pie       | Yin/Yang | Upper/lower | Left/right |
|---------------------------|--------------|-----------|-------------|-----------|--------------------|----------|-----------|----------|-------------|------------|
| EL                        | 125.4±47.11  | 200.32.1  | 138.6±53.22 | 200.32.2  | +13.2              | 59.19±19.42 | 63.8±42.56 | 10.8±7.40 | 12±8.37    | 3.25±3.95  |
| ES                        | 63.8±42.56   | 148.9      | 71.4±17.36  | 105.6±37.2 | +6.5               | 148.9±53.22 | 63.8±42.56 | 10.8±7.40 | 12±8.37    | 3.25±3.95  |
| Pie                       | 10.8±7.40    | 25.6±0.0  | 4.6±7.50    | 19.6±0.0  |                  | 23.0±8.0  | 9.25±7.27  | 22.5±2.63 |             |
| ES change                 |              | +0.10     |             |            |                    |          |           |          |             |            |
| t / P values              |              |          |             |            |                    |          |           |          |             |            |
| SD change                 |              | -2.06     |             |            |                    |          | -8.66     |          | -1.10      | -1.32      |

Tables 1a and 1b give pre and post intervention means and standard deviations for EL - Energy level; ES - Energy stability; PIE - Personal integrated energy; Yin-Yang balance, Upper-lower balance and Left-right balance for the 28 normal and 5 hyperactive subjects, respectively.
Pearson correlation tests on upper/lower
Left/right
\[ r = -0.716 \]
\[ r = 1.000 \]

Upper/lower balance
\[ r = -0.762 \]
\[ r = 1.000 \]

Pre-post difference
\[ P < 0.001 \]

| Variable                  | Upper/lower balance-pre | Upper/lower balance pre-post difference |
|---------------------------|--------------------------|----------------------------------------|
| Upper/lower balance-pre   | 1.000                    | -0.762, P < 0.001                      |
| Upper/lower balance       | -0.762                   | 1.000                                  |
| Pre-post difference        | P < 0.001                |                                        |

| Variable                  | Left/right balance-pre   | Left/right balance pre-post difference |
|---------------------------|--------------------------|----------------------------------------|
| Left/right balance-pre    | 1.000                    | -0.716, P < 0.001                      |
| Left/right balance        | -0.716                   | 1.000                                  |
| Pre-post difference        | P < 0.001                |                                        |

Table 3a: Pearson correlation tests on upper/lower balance variables

Table 3b: Pearson correlation tests on left/right balance variables

The implication that, yoga improves overall regulation of physiological systems, could be of considerable importance. It requires further testing in other experimental systems. Health or wholeness of system functioning requires balance, and this requires sensitive regulation. The more sensitive the regulation, the more accurately balance can be maintained, i.e. in some sense, the more robust the healthy state. From this perspective, optimal regulation will correspond to a state of optimal health. Through the recognition that heart rate variability is an essential component of health, this idea is already in the medical literature, because HRV is optimized when regulation is, in a precise sense, made most sensitive.

CONCLUSIONS

Our findings concerning AcuGraph seem largely consistent with those of Meenakshy and Mist. AcuGraph does not provide accurate enough information about individual meridians, but analysis of data from groups reduces standard deviation enough to make it a useful analytic tool for studying general effects of interventions on groups.

Based on this consideration, before and after measures of the three week yoga life-style intervention on 33 healthy young adults supported the hypothesis that overall Chi energy for the group would be increased. The fact that this increase showed no sign of leveling off for high starting EL values was a surprise. Further health research is required in this area: possibly, subjects with high initial AcuGraph energy level values should receive special training to prevent further increases to levels where they might become dangerous.
As regards the variables, upper-lower and left-right balance, AcuGraph averages strongly suggested that the standard deviations of distributions were significantly reduced, bringing subjects at both ends of the distributions back within the healthy range.

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