

Autonomic and Respiratory Measures in Children with Impaired Vision following Yoga and Physical Activity Programs

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Abstract : We conducted assessments of twenty eight children with impaired vision (VI group), with ages ranging from twelve to seventeen years and in an equal number of age-matched, normal sighted children (NS group). The VI group had significantly higher rates of breathing, heart rates, and diastolic blood pressure values, compared to the NS group (Mann- Whitney U test). Twenty four of the VI group formed pairs matched for age and degree of blindness and were randomly assigned to two groups, viz. yoga and physical activity. Both groups spent an hour each day practicing yoga or working in the garden depending on their group. After 3 weeks, the yoga group showed a significant decrease in breath rate (Wilcoxon paired signed ranks test). There was no change after the physical activity program. The results showed that the visually impaired have higher physiological arousal than the normal sighted with a marginal reduction in arousal following yoga.

Key words : visual impairment, normal sight, autonomic measures, yoga, gardening.

INTRODUCTION

Young people with impaired vision have significantly higher levels of anxiety related to physical injury, compared to an age-matched group of subjects with normal vision (Ollendick et al., 1985). In addition, one study reported that in comparison to persons who have vision, persons who are blind have a significantly higher heart rate while walking along an unfamiliar route, as well as for five minutes after it (Wycherley and Wicklin, 1970). The authors ascribed this to psychological, rather than physical stress.

The purpose of the life present study was to compare the autonomic and respiratory measures of children with congenital visual impairment with those of a group of age and sex matched children with normal vision. This was the first part of the study. The second part of the present study aimed at comparing the effects of yoga practice with physical activity, in children with visual impairment. The practice of yoga, as based on relaxation (Nagendra, 1989), is able to bring about reduced sympathetic activity alongwith other physiological signs of reduced arousal (Wallace et al., 1971; Joseph et al., 198 1).

METHODS

Subjects

In the first part of the study, we selected twenty eight children (aged between 11 and 17 years, group average age \pm SD, 14.2 ± 1.9 years) at random from a special school for the visually impaired (Raman Maharshi Academy for the Blind, Bangalore, India). All of them had congenital visual impairment with an uncorrectable visual acuity of 6/60 or less in the better eye from birth, which is the conventional description of blindness (Sheridan, 1969). Blindness was due to peripheral causes, e.g., microphthalmos, congenital cataract or optic atrophy. We selected twenty eight children with normal vision (6/6 without correction) so as to exactly match those with impaired vision with respect to age and sex. We obtained the informed consent of the subjects and their guardians in accordance with the ethical guidelines of the Indian Council of Medical Research, New Delhi, India.

The second part of the study involved twenty four children of the twenty eight assessed in the first part of the study. These twenty four children were selected as they could be matched to form pairs, on the basis of age, sex and degree of visual impairment. The method for grading has been described below, under 'Measurements'. We then randomly assigned subjects of a pair to either

of two groups, viz., yoga or physical activity. The group average age \pm SD was 14.1 ± 1.9 years (yoga group) and 14.1 ± 2.2 years (physical activity group).

Design of the study

In the first part of the study forty children with ages between 11 and 17 years were selected at random from among a total of three hundred and forty children attending a special school for the blind. Out of the forty, twenty eight children with congenital visual impairment were selected for the first part of the study (VI group), as these could be exactly matched with twenty eight children with normal sight (NS group). Matching was based on age and sex. Both groups (visually impaired and normal sighted) were assessed under similar conditions, described in detail below.

The second part of the study was conducted on twenty-four children with impaired vision, out of the twenty eight assessed in the first part of the study. The baseline assessment was carried out in the same way as the first part of the study, one month later. After this the yoga group received training in yoga, while the physical activity group spent time in an outdoor activity (i.e., gardening) for the allotted hour, for five days a week. The yoga instructor spent an equal amount of time with children of both groups. After three weeks both groups were assessed once more. The final assessments were performed by the same persons, under similar conditions as the baseline assessments.

Measurements

Recordings for the first part of the study (VI group versus NS group), as well as for the second part (yoga versus physical activity group of visually impaired children), were made in a moderately lit, sound attenuated room. After an initial 15 minute period of supine rest, assessments were made for 10 minutes, also in the supine position and with eyes closed. The blood pressure was recorded from the right arm using a standard sphygmomanometer while the subject was seated. It was not possible to obtain blood pressure records for the second part of the study.

A 10 channel polygraph (Polyrite, Recorders and Medicare, Chandigarh, India) was used to record the electrocardiogram (EKG), respiration and skin resistance level (SRL). EKG was recorded using standard limb lead 1 configuration. Skin resistance 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 current of 10 microamperes was passed between the electrodes. Respiration was recorded using a volumetric pressure transducer. Subjects were asked to stand erect and the transducer was fixed around the trunk, approximately 5 cm below the lower costal margin. The blood pressure was recorded with a sphygmomanometer.

The degree of visual impairment was graded for all the children with impaired vision as follows: grade 0, the inability to differentiate between light and dark; grade 1, the ability to differentiate between light and dark; grade 2, the ability to perceive gross movements; and grade 3, ability to count fingers held at a distance of 30 cm.

Data extraction and analysis

Data extraction was carried out similarly for both parts of the study. The heart rate (in beats per minute) was obtained by counting the QRS complexes in successive 60 sec epochs, continuously. The breath rate (in cycles per minute) was similarly calculated by counting the breath cycles in 60 sec epochs, continuously. The SRL was sampled at 20 sec intervals. For each subject the average of the values obtained during the 10 minute session was used for analysis.

The data of the V1 group and the NS group were compared using the Mann-Whitney U test. The data of the yoga and physical activity groups obtained at the end of three weeks were compared to the respective baseline data using the Wilcoxon paired signed ranks test.

Yoga training

Yoga was taught by a trained instructor. Individuals with normal vision learn yoga by observing a demonstration while listening to instructions. In the visually impaired detailed verbal instructions were given to compensate. In addition, the instructor spent time with each subject correcting their practice (e.g. repositioning their limbs) with verbal instructions. Special emphasis was given to relaxing between practices and being aware of body sensations. Practices included simple yoga postures and yoga breathing exercises (50 minutes), followed by guided relaxation (10 minutes). Throughout the practices the emphasis was on awareness (of physical and other sensations) and relaxation.

Physical activity

The physical activity group did not learn yoga. During the allotted hour they spent time in the garden, doing a comparable amount of physical activity as the yoga group, such as bending forwards and stretching upwards. The yoga instructor spent time with these children every day and was equally familiar with them as with the yoga group.

RESULTS

Part one of the study

In a comparison with the normal sighted, subjects with impaired vision had significantly higher breath rates, diastolic blood pressure values, and heart rates. For breath rate: $Z = 2.71$ and $Z_{.01} = 2.57$, hence $P < .01$; for diastolic blood pressure: $W = 3.79$ and $Z_{.001} = 3.20$, hence $P < .001$, and for heart rates: $Z = 1.66$ and $Z_{.05} = 1.64$, hence $P < .05$. The group mean values \pm SD are presented in Table 1.

Part two of the study

There was a significant decrease in the breath rate of the yoga group, at the end of three weeks using the Wilcoxon paired signed ranks test ($T = 10$, $T_{.05} = 12$, hence $P < .05$). The group mean values \pm SD are presented in Table II.

DISCUSSION

The present study was carried out in two parts. The first part of the present study showed that children with impaired vision had higher diastolic blood pressure values, heart and breath rates, compared with normal sighted children of the same age. When the children with impaired vision were randomly assigned to yoga and physical activity (i.e., gardening groups), three weeks of yoga practice caused a reduction in the rate of breathing.

An increase in breath rate has been correlated with experimentally evoked fear and anxiety (Ax, 1953), as well as before situations such as parachute jumping (Fenz and Jones, 1972). The nature of waveforms recorded in a standard spirogram using a strain gauge transducer showed that there were different patterns as the immediate response to six selected emotions, including fear and anxiety (Bloch et al., 1991). These two emotions were found to be particularly likely to cause irregularity of breathing, with frequent periods of breath holding, whereas anger and sadness were found to produce regularly recurring abnormal patterns. Visual assessment of the records of the children with impaired vision and those with normal sight showed that the former had irregular breath cycles with frequent periods of breath holding. This may be due to higher levels of fear and anxiety in the visually impaired. This is in keeping with the report which described higher levels of fear (particularly related to physical injury) in the visually impaired

(Ollendick et al., 1985). These subjects were possibly apprehensive as they were not familiar with the laboratory. In connection with this it may be noted that the subjects with normal sight were also visiting the laboratory for the first time. Also, equal efforts were made to reduce the apprehension of both groups by explaining the procedure in detail and answering their questions.

A low resting heart rate is an indicator of routine physical activity (Williams and Sperry, 1962). Children with impaired vision were found to have poor physiological adjustment to exercise compared to their normal sighted counterparts (Hopkins et al., 1987). This was ascribed to an overall lower level of physical activity in these children. This explanation for a higher resting heart rate found in the children with impaired vision in the present study, could also apply to the higher (though not abnormally so) diastolic blood pressure values in the blind children.

In the second part of the study, the effect of two programs (yoga and increased physical activity during gardening) was assessed, using the same parameters as for the first part of the study. Previous reports have shown that yoga reduces psychophysiological signs of arousal (Wallace et al., 1971). The present results have shown that the yoga group showed a significant reduction in respiratory rate after three weeks of practice, while the group who were given gardening showed no change. The effects of yoga on the rate of respiration have been described in the previous literature. The practice of yoga reduces the breath rate, both as an immediate effect (Wallace et al., 1971) and over a three month period (Joseph et al., 1981).

The present study showed that the practicing yoga for three weeks reduced the breath rate in children with impaired vision. Other known effects of yoga practice (e.g. a reduction in heart rate or an increase in skin resistance) were not observed. In fact, there was a non significant decrease in skin resistance following yoga, which could not be explained. It is possible that the duration of practice required to bring about a change in these parameters in the visually impaired is longer than in other individuals, as the latter have higher heart and breath rates and diastolic blood pressure values to begin with. These higher values may have been contributed to by the unfamiliar laboratory setting.

The practice of yoga modified the irregularity of breathing which was observed in the baseline assessment. These results are similar to the effects of yoga observed in community home children (Telles et al., 1997). As described earlier, an increase in breath rate was found to occur in response to fear, anxiety and other psychological stressors (Ax, 1953).

Hence the present results suggest that the visually impaired have higher levels of cardiac sympathetic activation and faster breathing than the normal sighted. A comparison of three weeks of yoga practice with a physical activity program showed that after the practice of yoga, the rate and irregularity of respiration was reduced. There were no other changes. Yoga techniques involve increased physical activity, with an emphasis on relaxation and awareness. This type of program appears to be useful to reduce irregularities in breathing which may be associated with anxiety, in the blind.

TABLE 1 : Autonomic measures in visually impaired (VI) and normal sighted (NS) children.
Values are group mean \pm SD

	VI (N = 28)	NS (N = 28)
Heart rate (beats per minute)	88.8 14.5	81.6 11.3
Breath rate (cycles per minute)	22.8 5.4	19.2 3.2
Skin resistance (K. ohms)	176.7 ±153.3	136.9 ±100.9
Systolic BP (mm Hg)	113.0 ± 11.5	110.7 9.5
Diastolic BP (mm Hg)	76.1 ±6.4***	66.5 8.9

*P < 0.05 (1), ** P < 0.01 (2), *** P < 0.001 (2) Mann - Whitney U test, "VI" versus "NS".
N = Number of subjects

TABLE II: (Yoga, physical activity) of children with impaired vision before and after the three week programs. Values are group mean ±SD

	Yoga training N = 12		Physical activity N = 12	
	Before	After	Before	After
HR (beats 1 minute)	89.0 ±19.4	82.8 ±13.4	84.7 ±8.1	84.9 ±12.3
RR (cycles 1 minute)	21.4 ±6.3	17.5* ±6.9	22.9 ±5.1	21.5 ±4.8
SR (Kilo ohms)	130.8 ±124.8	67.6 ±74.0	128.7 ±1.3.0	136.3 ±172.6

*p < 0.05 (2), Wilcoxon paired signed ranks test after versus before.
N = number of subjects

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