

Muscle Power Dexterity skill and Visual Perception in Community home girls trained in yoga or sports and in regular school girls

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Abstract: The present study was conducted to compare critical flicker fusion frequency (CFF), degree of optical illusion ("di"), dexterity scores, and grip strength in three groups of subjects, viz community home girls who had learned yoga for 6 months (CHY), age-matched community home girls who had physical activity training for 6 months (CHP), and girls who were attending a regular school (SCH). There were equal numbers in each group for each of the 4 assessment (range 11 to 30 subjects) and age range was 12 to 16 years. The CHP group had significantly lower CFF and "di" was significantly higher (one factor ANOVA, t test for unpaired data) in the CHP group, both compared to CHY and SCH groups. Right hand grip strength was also significantly less in the CHP group compared to SCH. The results were explained by previous reports of high levels of anxiety and aggression in community-home groups, which is known to influence the four parameters described here. The better performance of the CHY group compared to CHP, suggested that yoga practice has a beneficial effect in these subjects.

Key words: community home; physical activity; yoga; motor strength and skill; visual perception.

INTRODUCTION

Children who are unable to adjust at home, at school or in society are admitted to community homes. Previous studies have established that these children were socially and emotionally traumatized, although physically normal (1). They also reported anxiety and fears and were more aggressive. A report on physiological measures showed that the resting electrical activity in selected facial and back muscles (EMG) was significantly higher in community home boys compared to boys of the same age in an ordinary school (2). This increase was attributed to a high level of stress, as the EMG tone was found to decrease after the subjects underwent a program which included both physical training and relaxation. A subsequent report compared the effects of increased physical activity with those of relaxation with awareness through yoga in community home girls (3). To begin with, community home girls had higher respiratory rates and lower skin resistance values compared to an age matched group of girls who were staying at home and attending a regular school. At the end of six months the community-home yoga group had a greater decrease in heart rate, respiratory rate and an increase in skin resistance, compared to a matched, community-home physical activity group. These changes also suggested that yoga decreased physiological signs of stress.

The present study was conducted to compare the motor and sensory (visual) performance of community home girls who had learnt yoga with that of community- home girls trained in physical activity and of girls staying at home. Four tests were used, viz. (i) hand grip strength as an indicator of muscle power, (ii) degree of optical illusion using Muller-Lyer lines as a measure of accuracy of visual perception, (iii) critical flicker fusion frequency also to assess visual perception, and (iv) tweezer dexterity to assess motor skills. The community-home girls belonged to two categories. Prior to the assessments one category had training in yoga for six months, while the other category had a program of increased physical activity for the same duration. This study also compared both categories of community-home girls with age matched girls from an ordinary school.

METHOD

Subjects

The subjects were 80 girls from a state community-home. They were between 12 and 16 years of age and had been admitted because of difficulty in adjusting at home, at school, or in society. Fifteen were from broken homes, with one or both parents dead or separated. Their duration of stay in the home ranged from 6 to 36 months. The 80 girls were divided into pairs matched for age and duration of stay in the home. It was possible to form 30 such pairs. Subjects of a pair were randomly assigned to either one of two groups viz., yoga (CHY) and physical activity (CHP). A third group of girls who were staying at home and attending an ordinary school (SCH), were matched as far as possible for age (+ 6 months to 2 years) with the two groups from the community-home. All three groups (CHP, CHY, SCH) were assessed similarly. However, it was not possible to collect data on the degree of optical illusion in the control (SCH) subjects. Hence data obtained on adults living at home were used as control values. For each of the tests the number of subjects was different (Table 1).

Design of the Study

All three groups i.e., community-home group who had practised yoga for six months (CHY), community-home group who had training in physical activity for the same duration (CHP), and girls who were staying at home and attending a normal school (SCH), (or as described above, for the degree of illusion assessment, normal adults), were assessed for each of the four tests (detailed below) on four separate occasions.

Parameters: All subjects were assessed in the four parameters described below.

(i) Hand grip strength was measured using a hand grip dynamometer. Subjects were asked to extend their arms horizontally parallel to the ground, without support and grip the dynamometer using maximum strength. Three trials were given for each hand, alternately, with 10 Sec gap between trials, the highest among the three values was used for analysis

Table 1. Number of subjects (n) and mean age \pm SD of each group for all the four assessments.

Assessment	n	CHY		CHP		SCH	
		mean age	SD	mean age	SD	mean age	SD
Grip strength	11	13.9	1.3	13.6	1.4	13.8	1.1
Tweezer dexterity	15	13.6	2.9	13.8	1.8	11.4	1.8
Critical flicker fusion	30	13.9	1.9	12.9	2.6	13.6	1.5
Optical illusion	30	13.9	1.9	12.9	2.6	28.9*	6.3

* = adult subjects

(ii) Tweezer dexterity was measured using the O'Connor tweezer dexterity apparatus, which consists of a metal plate which has 100 holes (2.0 mm in diameter and 20.0 mm deep) spaced 15.0 mm apart. The subject was instructed to pick up metal pins (1.5 mm in diameter and 25.0 mm in length) with a tweezer and place them in the holes as quickly as possible. The number of pins placed within 4 min was noted.

(iii) Critical flicker fusion frequency was measured using an electronic flicker fusion apparatus, with flicker rate ranging from 12 to 95 Hz. The flickering stimulus was a red light, 6 mm in diameter with intensity of 50 mcd, surrounded by a white surface with illumination of 150 lux. Subjects were seated 50 cm away from the apparatus, with their gaze on level with it. All subjects were assessed in ten ascending trials, which began with minimum frequency (12 Hz for the apparatus used). The frequency was increased at the rate of 0.5 Hz per step, till the subjects felt that the stimulus was no longer flickering, i.e. it was "fused" (fusion threshold).

(iv) Optical illusion was measured using Muller-Lyer lines. Subjects were assessed in two types of trials, i.e., "in" and "out" using "the method of limits" with the experimenter varying the lengths of the lines. The Muller-Lyer lines, though of equal length, appear unequal due to two different types of arrows drawn at the ends of the line. In the apparatus used, for the present study, the line on the left had close-ended arrows at either end, making it appear shorter. The length was fixed (in mm). In contrast the length of the line on the right could be varied. This line had open-ended arrows at either end which made it appear longer. The experimenter manipulated the length of the line according to the subjects specifications. The exact position at which the subject perceived the two lines to be of equal length was noted, i.e. subjective reading - "sr". The difference between the reading at which the lines were actually equal and the "sr" gave the degree of illusion, "di". Each subject of three groups was assessed in two types of trials (ten each, given alternately). For "in" trials the examiner adjusted the length of the adjustable line, 1 mm at a time, changing the length from maximum (200 mm) till the subjects perceived the length to be equal to that of the fixed line (actual length = 160 mm). For "out" trial the procedure was reverse, the adjustable line was kept to minimum length and the length was gradually increased till the subjects perceived the length to equal that of the fixed line. In both cases the difference (in mm) between the actual length of the fixed line and the perceived length was noted as the degree of illusion, "di".

For all 4 tests the apparatuses were from Anand Agencies, Pune, India

Yoga training

Staff members of the community-home who were previously trained in yoga, were involved in teaching and supervision. A trained yoga teacher visited the class every fortnight to check the practice. Yoga techniques included: (i) simple yogasanas for 50 minutes (these are postures which are maintained for as long as possible, while relaxed), and (ii) a 10 minute period of relaxation in shavasana (corpse posture). Throughout both practices the emphasis was on relaxation and awareness of physical and other sensations.

Physical activity

Physical activity training included stationary jogging, rapid bending forwards and backwards, twisting and bending sideways. These practices were for 40 minutes. The session also included 20 minutes of playing games such as relay races in which all the girls had to participate actively.

RESULTS

The data for all four assessments (grip strength, tweezer dexterity, critical flicker fusion frequency, and degree of optical illusion (Muller-Lyer lines)) of the three groups were compared for significant differences using separate single-factor analysis of variance (ANOVA). The group average values were tested for significant differences using the 't' test for unpaired data comparing two groups at a time. The single factor ANOVA showed a significant difference between the critical flicker fusion frequency values of the 3 groups, [F = 18.36, F.001 (2) 2, 87 = 8.30, hence P < .001] and for the degree of optical illusion using the Muller-Lyer lines during "in trials" [F = 18.99, F.001 (2) 2, 87 = 8.36, hence P < .001]

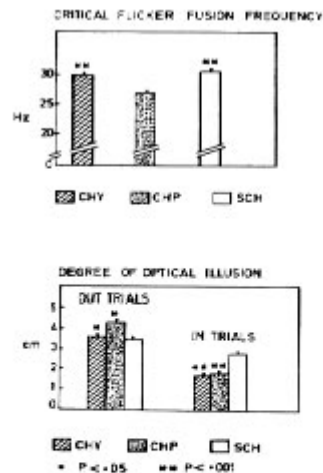


Fig.1: Critical flicker fusion frequency and degree of optical illusion in community home yoga group (CHY) and community home physical training group (CHP) compared to ordinary school group (SCH). *P<.05, **P<.001, 't' test for unpaired data.

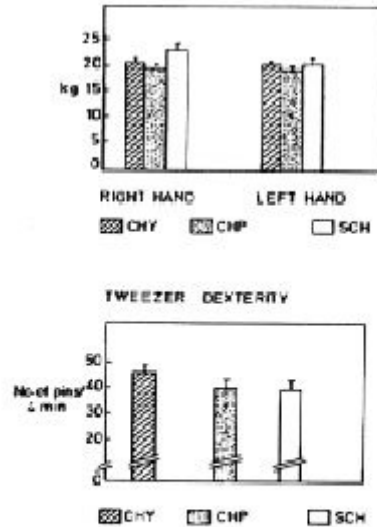


Fig.2: Hand grip strength and tweezer dexterity scores in community home yoga group (CHY) and community home physical training group (CHP) compared to ordinary school group (SCH).

(Fig.1) There was no significant difference between the three groups for degree of optical illusions for "out trials", hand grip strength scores obtained for either hand or for the tweezer dexterity scores ($P < 0.1$ in both cases) (Fig 2).

The 't' test for unpaired data showed the following significant difference (i) Critical flicker fusion frequency was significantly lower in the CHP group, compared to SCH group ($t = 5.72$, $P < 0.01$) and 'compared to CHY group ($t = 5.72$, $P < 0.01$). (ii) Degree of optical illusion for "out trials" i.e. the "di" was significantly higher (marginal difference) in the CHP group compared to SCH ($t = 1.92$, $P < 0.05$). (iii) Grip strength was significantly lower in 'CHP group compared to SCH group for the right hand ($t = 2.00$, $P < .05$, one tailed).

DISCUSSION

The present study showed that community home girls who had received physical training (CHP group) have significantly lower critical flicker fusion frequency (CFF), higher degree of optical illusion ("di") for "out trials", but not for "in trials", and lower right hand grip strength compared to girls of the same age who were staying at home and attending an ordinary school (SCH group). The community home girls who had received six months of training in yoga (CHY group) performed better i.e. higher CFF, 'lower "di" an "out trials" and marginally greater hand grip strength, than the CHP group, and were not significantly different from the SCH group. The data of the community home groups before they had learned yoga/physical training were not available. Hence the base line performance of these groups of subjects was not known. The hand grip is believed to be influenced by the availability of energy and oxidation requirement (12).

The CFF has been correlated with factors such as physical stresses e. g. nutritional deficiency, fatigue during physical work, or sleep deprivation (4) as well as emotional stress (5). Greater stress levels have been correlated with lower CFF values. The "di" has also been correlated with cognitive factors such as the experience, hypotheses, and strategies of judgement (6). In the present study, the lower CFF values and higher "di" in the "physical activity" community home group could possibly be related to the higher stress levels, which earlier reports indicated that these subjects were specially likely to have (1, 2, 3). The CHY group did not have significantly

different values for both CFF and "di" compared to SCH group. This could be related to the fact that the practice of yoga for short periods (10 to 30 days) has been shown to increase the CFF (7) and reduce optical illusion (8). The hand grip strength and tweezer dexterity scores did not differ significantly between the three groups using a single factor ANOVA. However, the 't' test for unpaired data showed a significantly lower right hand grip strength in the CHP group compared to SCH group. The absence of major differences between the groups for these two parameters could be explained in either of two ways, viz (i) the factors responsible for lower visual sensitivity (low CFF, high "di") in the CHP group of community home girls may not be applicable to grip strength/tweezer dexterity; (ii) alternatively, both yoga and increased physical activity may have been effective in the reducing adverse factors in the CHP and CHY groups with regard to grip strength or dexterity scores while there were still differences in CFF and "di". The grip strength and dexterity scores of the three groups hence appeared the same. The former explanation is contradicted by a very early report in the literature which describes poor performance in "asylum" children when hand grip strength and manual dexterity were tested (9). The latter explanation may be more acceptable. There are reports that the practice of yoga increases grip strength (10) and improves dexterity. A previous study has shown a comparable effect of yoga and physical training on grip strength and specific tasks requiring motor skills (11). This also may explain why no differences were observed between the two groups of community home girls for these two parameters, even though the CHP group had lower right hand grip strength than the SCH group. The physiological basis for the perception of optical illusion and of a flickering light stimulus are similar. In both cases changes at retinal, cortical and cognitive judgemental levels influence visual perception. However, in the case of flicker fusion, the peripheral visual pathway is specially important, and may be related to the frequency at which the optic tract discharges and to the discharge rate of "on-off" ganglion cells in response to an intermittent stimulus. Also in the perception of an optical illusion cognitive-judgemental factors are stressed (6).

The hand grip is believed to be influenced by the availability of energy and oxidation requirement (12). These factors may also be expected to influence the performance in a repetitive task requiring fine motor skills (i.e. the, dexterity test).

Hence the present study suggests that the reported higher stress levels in community home inmates reduced sensory perception by causing change at peripheral and central levels. To some extent yoga practice modifies this effect. Similarly muscle power (but not fine motor skill), was less in the community home group. Yoga practice also appeared to improve hand grip strength, perhaps by reducing the energy requirement. However, additional information on the baseline status of the community home group, prior to either training (which was not available in the present study) would be required to draw more definitive conclusions.

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