INTRODUCTION

Schizophrenia affects persons in the productive age group and the majority of the affected have a chronic course. Consequently, the disorder ranks in the top ten causes of disease-related disability in the age group 15 to 44 years.[1] Despite best antipsychotic medications, residual symptoms particularly in the form of negative and cognitive symptoms, produce significant disability.[2] Treatment strategies, individually or in combination, are hence aimed at containing these symptoms.

Some of these include rehabilitation, behavior modification, and other psychosocial therapies, which produce variable...
benefits. Cognitive retraining has been shown to have salutary effects on cognition and global functioning in patients with schizophrenia.[3] Yoga has emerged as an attractive add-on intervention. Cognitive benefits have been obtained with addition of Yoga in patients with schizophrenia residing in an institutional setting.[4] Most patients with schizophrenia, however, can remain on outpatient follow up, though they may have residual symptoms. Duraiswamy et al.[5] evaluated a yogasana regimen against comparable duration of non-yoga exercises as an add-on therapy to outpatients with schizophrenia “stabilized” on antipsychotics. Both groups of patients improved with respect to negative symptoms and social functions over four months, more so in the yogasana group. The authors concluded that yogasana and, if not available, exercise should be added to the therapy for patients with schizophrenia. However, it is not known if this benefit observed was due to the time lag alone. Therefore, the present study was designed to control for this nonspecific time-lag effect. Efficacy of add-on yogasana was compared with exercise and a waitlisted group in three groups of outpatients with schizophrenia, with the hypothesis that Yoga would be more efficacious than physical exercise, which in turn would be better than waitlist.

MATERIALS AND METHODS

The study was conducted at the National Institute of Mental Health and Neurosciences, a large psychiatric hospital with both inpatient and outpatient services. The Institute’s ethics review committee approved the study.

Patients attending outpatient services on follow-up with a diagnosis of schizophrenia were screened for the following: (a) receiving antipsychotic medication without change in dosages in the last three months, (b) rated as moderately symptomatic with a score of 3 or more on clinical global impression,[6] and (c) not received Electro Convulsive Therapy (ECT) in the past three months. They were initially invited to participate in this three-group randomized study. They received detailed explanation about the procedures and were told that they had a right to withdraw the consent during the study. Permission was also obtained from the treating consultants that patients will be randomized and followed up for assessments in the next four months without change of medication status unless absolutely needed. Where possible, their caregivers were also contacted. They were explained about the nature of study and their consent to accompany patients to therapy and follow-up sessions was obtained. A psychiatrist confirmed the diagnosis of schizophrenia according to Diagnostic and Statistical Manual IV (DSM-IV)[7] criteria before allocating the random number.

Random allocation

One investigator (JT) uninvolved in the treatments or assessments generated random numbers for 120 patients to be allocated to three groups of approximately equal numbers. A subject’s allocation to one of these groups was kept concealed and was ascertained only after he/she consented and when he/she was to be randomized. Only the social worker and the yoga therapist in the study were informed to start the corresponding intervention. The rest of the research team was unaware of the current group allocation. The three groups allocated were yogasana (n=47), exercise (n=37), and waitlist (n=36). Assessments began after allocation.

Assessments

A trained clinician rated the patients on the following instruments: (a) Positive and Negative Syndrome Scale (PANSS),[8] (b) Social and Occupational Functioning Scale (SOFS),[9] and (c) Extra Pyramidal Symptoms.[10] These assessments were conducted before staring the interventions and four months thereafter. Variable number of patients (not all) also attended scheduled follow-up visits at the end of the supervised yoga therapy and a month thereafter, but we have used the data of only the baseline and 4th month’s assessment data. The rater was unaware of group allocation. Interventions of the research were initiated following first assessment.

Improvement

Drop in scores between baseline and 4th month assessment were computed as arithmetic difference to operationally define improvement in a given patient as follows: a drop of 15 for PANSS total score, a drop of 7 each for PANSS negative and positive scores, and a drop of 14 for SOFS total score.

Yogasana

This included a set of procedures detailed elsewhere.[5] The regimen included certain postures and breathing patterns. No component of meditation was included. A certified yoga teacher taught these to all patients in the first month. Each session was of 45-minute duration. They were expected to attend 25 sessions in the first month.

Exercise

The procedures were drawn from a standard package as described elsewhere.[5] Each session lasted for 45 minutes and like in the yogasana group, about 25 sessions were offered in one month.

Waitlist

These patients received treatment as usual, similar to the two other groups, but neither yoga nor exercise. This group was offered one month of either of the two as they preferred but only after study period (4 months). Fourteen patients chose to receive yogasana for a month after the study period.

Participation incentive

No patient was offered any incentive to participate in the study. However, to facilitate the participation, bus fare or
bus pass was provided to the patient and the relative to travel between their residence and the yoga center.

**Dropouts**

In both the two active intervention groups, variable number of patients failed to complete 75% attendance (defined as adequate) to the sessions. Likewise, some did not turn up at the 4th month follow-up and therefore the final sample was smaller; 39, 22, and 34 in yogasana, exercise, and waitlist groups, respectively.

**Practice at home**

Patients who learnt yogasana or exercise were expected to practice the same at home. The relative who accompanied the patient during the one-month training was requested to encourage the patient to practice these at home. Patients were given a log book to verify the regularity of practice and bring the same at their monthly follow-up visits. This latter was poorly followed by patients; negligible number brought the books at follow-up. It is difficult, therefore, to authenticate the home-practice.

**Analyses**

The data were managed by one investigator (JT) uninvolved with the treatment, follow-up, or assessments. This investigator generated and maintained the random sequence and ensured allocation concealment. The three groups were compared at baseline as regards the variables using ANOVA or chi-square test as was relevant. The baseline variables on PANSS and SOFS did not follow normal distribution (Shapiro-Wilk test of normality; \(P<0.001\)), and hence subsequent analyses were nonparametric. To compare the change from baseline to 4th month assessments in each of the three treatment groups, Wilcoxon sign rank test was used for four variables (PANSS negative, positive, and total as well as SOFS). Accordingly, Bonferroni correction for each variable’s alpha values was applied (i.e., alpha value was set at \(P<0.05/3=0.016\)). To test the hypothesis that yoga therapy is more efficacious than physical exercise, which is in turn is more efficacious than waitlist, Kendall’s Tau statistic was used. Odds ratios with 95% confidence intervals were computed to compare the proportion of patients showing improvement across individual interventions with one another. Primary outcome variable was PANSS scores and the secondary outcome variable was SOFS scores.

**RESULTS**

In a period of about 20 consecutive months, 941 patients were screened for the study. The consenting patients \((n=119)\) in the three groups were comparable with regard to demographic variables [Table 1]. At 4th month follow-up, 24 patients were unavailable (four from yoga, 14 from exercise, and three from waitlist groups). The 24 patients who dropped out were not significantly different from the 95 who completed on age \((t=1.40; P=0.16)\), sex \((\text{chi-square}=0.14; P=0.80)\), level of education \((\text{chi-square}=2.20; P=0.33)\), and PANSS scores at baseline \((\text{PANSS positive}, \ t=-0.71, \ P=0.48; \ \text{PANSS negative}, \ t=-1.06, \ P=0.29; \ \text{PANSS total}, \ t=-1.24, \ P=0.56)\). Among the 95 patients who completed (39 in yoga, 22 in exercise, and 34 in waitlist groups), baseline clinical variables were comparable [Table 2].

Reductions occurred in the PANSS (negative and total scores) and SOFS scores between baseline and 4th month assessments, and remained significant after Bonferroni correction in the Yogasana group [Table 3]. Subjects in the exercise group also obtained significant reduction in SOFS score, but neither the exercise nor the waitlisted groups obtained any significant reductions in any of the other outcome variables. The proportions of patients who obtained “improvement” in PANSS negative, PANSS total, and SOFS scores were higher in

| Table 1: Demographic variables across the three groups at baseline |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| **Variable**    | **Groups**      | **Chi-square**  | **P**           | **Yoga N (%)**  | **Exercise N (%)** | **Waitlist N (%)** |
| Gender          |                 |                 |                | Male            | 28 (60.9)         | 28 (77.8)         | 27 (73)          | 3.00            | 0.22 |
|                 |                 |                 |                | Female          | 18 (39.1)         | 28 (22.2)         | 23 (27)          |                 |      |
| Education       |                 |                 |                | Primary and below | 9 (19.6)         | 6 (16.7)          | 4 (10.8)          | 1.94            | 0.75 |
|                 |                 |                 |                | Secondary       | 26 (56.5)         | 20 (55.6)         | 20 (54.1)         |                 |      |
|                 |                 |                 |                | Graduate and above | 11 (23.9)        | 10 (27.8)         | 13 (35.1)         |                 |      |
| Occupation      |                 |                 |                | Unemployed      | 40 (87.0)         | 29 (80.6)         | 28 (75.7)         | 1.76            | 0.41 |
|                 |                 |                 |                | Employed        | 6 (13.0)          | 7 (19.4)          | 9 (24.3)          |                 |      |
| Family income (monthly) | |                 |                | <Rs. 1700       | 34 (73.9)         | 24 (66.7)         | 29 (78.4)         | 2.22            | 0.70 |
|                 |                 |                 |                | Rs. 1700 – 4500 | 7 (15.2)          | 7 (19.4)          | 3 (8.1)           |                 |      |
|                 |                 |                 |                | >Rs. 4500       | 5 (10.9)          | 5 (13.9)          | 5 (13.5)          |                 |      |
| Marital status  |                 |                 |                | Never married   | 31 (67.4)         | 23 (63.9)         | 22 (59.5)         | 0.56            | 0.76 |
|                 |                 |                 |                | Ever married    | 15 (32.6)         | 13 (36.1)         | 15 (40.5)         |                 |      |

Number of patients in each group: Yoga=46, Exercise=36, Waitlist=37
In this sample of antipsychotic-stabilized schizophrenia patients who had an average illness duration of 10 or more years, add-on intervention of Yogasana was better than another add-on intervention (exercise) or mere wait listing. The patients learnt yogasana for one month and were advised to practice the same in the next three months at home. This resulted in significant reductions in not only the PANSS scores, but also improved social function ratings. Changes in the exercise or waitlisted groups of patients were not significant. More patients in the Yogasana group were improved as compared with the other two groups on these scales.

The findings confirmed the beneficial effects of add-on yogasana intervention in schizophrenia.[5] The present study is an improvement in the design over this previous study by way of having a no-add-on-intervention group (waitlist). Unlike a previous study in institutionalized schizophrenia patients,[4] those attending outpatient services were investigated. This was done as the latter category of patients represents a prototype patient of schizophrenia needing help. The present study was also aimed at investigating the effects of Yogasana that can be offered with less rigorous but practical once-a-day yoga sessions. This method of offering an add-on Yogasana intervention produced benefits.

The benefits though were significant statistically, may be clinically less so. The magnitude of difference was small. It must be realized, however, that on PANSS, their scores were at the lower end to begin with, and scope for further reduction may be smaller. At the end of 4 months, about a third could become “improved,” as defined operationally in schizophrenia.

Table 2: Baseline clinical variables of patients who completed the trial

| Variables            | Yoga mean (SD) | Exercise mean (SD) | Waitlist mean (SD) | Chi-square | P   |
|----------------------|----------------|--------------------|--------------------|------------|-----|
| Age                  | 32.8 (10.0)    | 30.6 (7.3)         | 33.6 (9.5)         | 0.92       | 0.63|
| Duration of illness (months) | 129.7 (96.6) | 88.6 (91.9)       | 121.5 (105.8)     | 4.09       | 0.13|
| PANSS positive       | 153.2 (4.3)    | 153.2 (4.3)        | 159.5 (5.3)        | 4.87       | 0.09|
| PANSS negative       | 18.1 (5.7)     | 15.2 (4.3)         | 15.9 (5.3)         | 4.87       | 0.09|
| PANSS general        | 29.4 (6.6)     | 28.6 (4.9)         | 27.9 (5.9)         | 1.23       | 0.54|
| PANSS total          | 68.2 (14.3)    | 59.1 (10.2)        | 58.5 (13.8)        | 1.94       | 0.38|
| SOFS                 | 31.6 (8.3)     | 27.8 (7.1)         | 28.2 (8.3)         | 4.42       | 0.11|

PANSS - Positive and negative syndrome scale (Kay et al., 1987); SOFS - Social and occupational functioning scale (Saraswat et al., 2006); #Kruskal-Wallis Test.

**DISCUSSION**

In this sample of antipsychotic-stabilized schizophrenia patients who had an average illness duration of 10 or more years, add-on intervention of Yogasana was better than another add-on intervention (exercise) or mere wait listing. The patients learnt yogasana for one month and were advised to practice the same in the next three months at home. This resulted in significant reductions in not only the PANSS scores, but also improved social function ratings. Changes in the exercise or waitlisted groups of patients were not significant. More patients in the Yogasana group were improved as compared with the other two groups on these scales.

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The benefits though were significant statistically, may be clinically less so. The magnitude of difference was small. It must be realized, however, that on PANSS, their scores were at the lower end to begin with, and scope for further reduction may be smaller. At the end of 4 months, about a third could become “improved,” as defined operationally in the Yogasana group as against less than 10% in the other two groups. Therefore, the changes seen in these four months cannot be merely brushed aside as a spontaneous variations in the course of a long-standing disorder. Instead, credit should be given to Yogasana intervention.

The magnitude of differences between the present study and the one published from the same center[5] are comparable. Also, the benefits obtained in negative symptoms have been replicated. This aspect of the illness is generally considered to

Table 3: Psychopathology and socio-occupational functioning scores at baseline and after 4 months

| Group     | Pre (Median [Interquartile range]) | Post (Median [Interquartile range]) | P# |
|-----------|-----------------------------------|------------------------------------|----|
| PANSS positive Yoga | 14 (11 – 18.25) | 11 (8 – 16) | 0.001 |
| Exercise | 14 (12 – 18) | 13.5 (8.5 – 19.25) | 0.40 |
| Waitlist | 14 (10 – 18) | 12.5 (8 – 19) | 0.30 |
| PANSS negative Yoga | 16 (14 – 21) | 15 (12 – 16) | <0.001 |
| Exercise | 15 (12 – 16) | 14.5 (9 – 16.25) | 0.08 |
| Waitlist | 16 (12.5 – 18) | 14 (12 – 17.25) | 0.10 |
| PANSS total Yoga | 60.5 (53 – 69.25) | 50 (45.25 – 55) | <0.001 |
| Exercise | 60 (54 – 63) | 52 (44.5 – 61) | 0.10 |
| Waitlist | 55 (47 – 65.5) | 50 (43.75 – 69.25) | 0.09 |
| SOFS Yoga | 29.5 (26 – 33.25) | 25 (20 – 28) | <0.001 |
| Exercise | 26 (22 – 31) | 21.5 (17.75 – 28.25) | 0.004 |
| Waitlist | 27 (22 – 32) | 25 (20.75 – 30) | 0.02* |

Number of patients in each group: Yoga=39, Exercise=22, Waitlist=34.

#Wilcoxon sign rank test. *Non-significant after Bonferroni correction.

PANSS - Positive and negative syndrome scale; SOFS - Social and occupational functioning scale

Table 4: Number and percentage of patients who showed improvement at 4 months in psychopathology and socio-occupational functioning scores

| Variable        | Yoga | Exercise | Waitlist | Kendall’s tau | P   |
|-----------------|------|----------|----------|---------------|-----|
| Positive PANSS  | 8 (20.5) | 6 (27.3) | 7 (20.6) | 0.45          | 0.97|
| Negative PANSS  | 13 (33.3) | 2 (9.1) | 3 (8.8) | -2.75         | 0.006|
| Total PANSS     | 14 (38.9) | 5 (25.0) | 3 (8.8) | -3.15         | 0.002|
| SOFS            | 6 (15.4) | 1 (4.5) | 1 (2.9) | -0.19         | 0.19|

Number of patients in each group: Yoga=39, Exercise=22, Waitlist=34.

PANSS - Positive and negative syndrome scale; SOFS - Social and occupational functioning scale

the yogasana group as compared with exercise or waitlisted groups [Table 4]. Odds ratio statistic indicated that Yogasana produced a 5-fold increase in the chance of obtaining improvement in PANSS negative scores as compared with either exercise (Odds ratio=5.000; 95% CI=1.32 - 20.1) or waitlist (Odds ratio=5.167; 95% CI=1.32 - 20.1). The likelihood of improvement in yoga group in terms of total PANSS score was about six times greater than in the waitlist group (Odds ratio=6.576; 95% CI=1.69 – 25.66). The interventions had no effect on drug-induced extrapyramidal ratings (data not presented).
be less amenable for corrections. Yogasana and not merely exercise conferred advantage in reducing negative symptoms. It may be noted that a recent Cochrane review has pointed to benefits of physical exercise in patients with schizophrenia.

It is not clear how each of these postures produce a psychobiological effect that is conducive for therapeutic effect. While practicing yogasana, attention needs to be paid on breathing pattern for attaining each posture. Cognitive remediation procedures use attention-enhancing procedures and have been found beneficial in schizophrenia. It is likely that Yogasana intervention could be providing this benefit in addition to that provided by physical postures and hence may be better than mere exercise. Yogasana postures without emphasis on attention to breathing may hence have to be compared with postures alone as regards to effects in schizophrenia. A sample from this study was also tested on an emotion-recognition task and the Yogasana group differentially benefited compared with the other two groups. This benefit on social cognition could be a result of the attentive component of Yogasana and indirectly also benefited the negative symptoms. The role of Yogasana on drug-induced extrapyramidal side effects was lacking and hence this explanation cannot be invoked for the benefits observed.

Would the Yogasana intervention have produced better clinical results than merely statistically significant ones? The practices were limited to asanas and pranayama variants only. Had the patients practiced all components of Ashtanga yoga, would the benefits have been more striking? The answer is a guarded “yes,” with some caveats. Yama and Niyama border on faith-related practices and hence can have variable effects. Also, Dhyana (meditation) has a risk of exacerbating psychosis. Some have highlighted the risk of activation of psychosis during meditation. Also, Dhyana, Dharaana, Pratyahara, and Samadhi procedures (also called Antaranga yoga, higher states of yoga practice) cannot be objectively verified. In patients who have schizophrenia, a good proportion of whom suffer from motivational defects, ensuring these more mindful practices poses a challenge. Once patients perfect asanas and pranayama, and provided they are under close supervision by both yoga and mental health specialists, other elements of yoga should be gradually introduced. This will ensure both a longer term Yogasana practice and also graduation to other elements of yoga that could be beneficial.

The rigor with which they may have practiced Yogasana at home is even more questionable. This cannot be verified as few patients adhered to the request of bringing the log/diary at follow-up assessment. As patients lived with their families (unlike in some other societies) and reported to follow up with a family member, the latter’s version, if the patient practiced these procedures (Yogasana/exercise), could be verified within the limits of certainty. It may also be noted that patients were subsidized as regards their travel expenses for the participation in the study. Yet, a substantial proportion did not adhere to the study needs. It is likely that some form of community Yogasana practice closer to the patients’ residences can facilitate adherence and benefits thereof. Alternatively, practices needing fewer days or lesser frequency of supervised training may make the intervention more patient-friendly and deserve evaluation. Introducing yogasana early in course of illness may have some advantages. The families as well as the patients are likely to become better motivated and the intervention may hence be more effective.

CONCLUSIONS

In summary, moderately symptomatic patients with schizophrenia who were on stabilized medications on outpatient follow-up obtained benefits from yogasana practices. Baseline to 4th month PANSS scores and social dysfunction ratings significantly dropped in the yoga group, but not in the waitlisted group. The exercise group patients showed a drop in social dysfunction scores only. Improvement occurred in about 35% of patients of Yoga group in contrast to fewer than 10% in the other two groups. As regards positive symptoms, no such benefit occurred with any interventions. The study is an improvement over an earlier one as regards the methodology, inclusion of a third group of waitlisted patients. The findings confirm previous study in that yoga produces significant, albeit modest, reductions in negative symptoms. This result should encourage adding of Yoga as a complementary therapy for patients with schizophrenia.

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