

# Yoga as an Adjuvant with Multimodal Psychological Interventions for Excessive Use of Technology: A Randomized Controlled Trial from India

## Abstract

**Background:** Multimodal approach of psychotherapy has been found to be effective for managing the excessive use of technology. Yoga, a holistic mind–body therapy, has been observed to be a useful adjuvant in managing substance use disorders. Yoga is also known to reduce stress and enhance overall well-being. The aim of this study was to examine whether yoga as an adjuvant treatment to psychotherapy alone in reducing dysfunction and severity due to excessive technology use. **Methods:** A two-arm randomized controlled prospective study design was followed with assessor blinding and allocation concealment. Thirty consenting young adults (22 males), scoring above 36 on the Internet Addiction Test, were randomly allocated to either: Group A = psychotherapy + yoga or Group B = psychotherapy alone. Both groups received 8 sessions of psychotherapy in the 1<sup>st</sup> month. In addition, Group A received additional 10 sessions a specific yoga program (by trained professionals). After that, monthly booster sessions (supervised yoga sessions performed with direct one-on-one contact with the yoga therapist) were organized and post-assessment was conducted at 12 weeks. Each subject was assessed using the Internet Addiction Test-Short Form, Internet Gaming Disorder Scale-Short Form, Smartphone Addiction Scale-Short Version, and Kessler Psychological Distress Scale at baseline and after 12 weeks. **Results:** As compared to Group B, Group A had significantly reduced Internet use ( $F = 5.61, P = 0.02, \eta_p^2 = 0.17$ ), smartphone use ( $F = 4.76, P = 0.03, \eta_p^2 = 0.15$ ), psychological distress ( $F = 7.71, P = 0.01, \eta_p^2 = 0.22$ ), and weekday use ( $Z = -2.0, P = 0.05, \eta_p^2 = 0.15$ ) along with enhanced treatment adherence and retention. **Conclusion:** Yoga as an adjuvant therapy with multimodal psychological intervention for excessive use of technology was found to be effective. This carries clinical implications for mental health professionals.

**Keywords:** Cognitive behavioral therapy, excessive use of technology, multimodal psychotherapy, technology addiction, yoga

## Introduction

Since the turn of the millennium, the processes of globalization and digitization have been progressing steadily. The widespread use of the Internet and communication technologies has made them both publicly accessible and increasingly indispensable, thereby presenting a potential health risk. The extensive utilization of technology has elicited grave concerns, as it may result in detrimental consequences for individuals' mental and physical well-being, such as addiction, depression, and anxiety.<sup>[1]</sup> The global pooled prevalence across 64 countries for digital addiction was 26.99% (smartphone and Internet).<sup>[2]</sup> The Diagnostic and Statistical Manual of Mental Disorders,

Fifth Edition (DSM-V)<sup>[3]</sup> and the International Classification of Diseases, 11<sup>th</sup> Edition<sup>[4]</sup> have both officially acknowledged Internet Gaming Disorder (IGD) as a diagnosis code. Excess technology use continues to be a serious health risk and concern for mental health professionals. However, the diagnosis of technology addiction is complicated by the diverse types of technology used<sup>[5]</sup> (such as the Internet, smartphones, and laptops) and the various functions for which they are utilized (including gaming, social media, pornography, and binge-watching). This article will focus on the excessive use of technology as defined as “excessive or poorly controlled preoccupations, urges, or behaviors regarding computer use and

**Ashwini Tadpatrikar,  
Manoj Kumar  
Sharma,  
Hemant Bhargav<sup>1</sup>,  
Nitin Anand,  
Priyamvada  
Sharma<sup>2</sup>,  
Shubham Sharma<sup>1</sup>**

*Department of Clinical Psychology, Service for Healthy Use of Technology Clinic, National Institute of Mental Health and Neurosciences, Departments of <sup>1</sup>Integrative Medicine and <sup>2</sup>Clinical Psychopharmacology and Neurotoxicology, National Institute of Mental Health and Neurosciences, Bengaluru, Karnataka, India*

**Address for correspondence:**  
Dr. Manoj Kumar Sharma,  
Department of Clinical Psychology, Service for Healthy Use of Technology Clinic, National Institute of Mental Health and Neurosciences, Bengaluru - 560 029, Karnataka, India.  
E-mail: shutclinic@gmail.com

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Internet access that led to impairment or distress<sup>[6]</sup> to be diagnosed by a clinician and screened using the Internet Addiction Test-Short Version (s-IAT).<sup>[7]</sup>

Most traditional forms of psychotherapy such as cognitive behavioral therapy (CBT) have been proven effective in managing Internet addiction. A systematic review and meta-analysis of 59 randomized controlled trials by Zhang *et al.* (2022)<sup>[8]</sup> showed that psychological interventions were effective in reducing Internet addiction severity and associated psychological symptoms such as anxiety and depression. In addition, CBT, group counseling, sports intervention, and Internet-based intervention could significantly reduce Internet addiction levels. Other meta-analytic reviews showed that psychosocial interventions targeting excessive technology use, Internet addiction, and gaming disorder positively improved the addiction severity, time spent online, and some mental health symptoms.<sup>[9-11]</sup> However, the impact on other outcomes, such as psychosocial competence and well-being, and the sustainability of the intervention effects were unclear.

Other than CBT, mindfulness-based approaches have been applied for behavioral addictions such as gambling<sup>[12]</sup> and workaholism<sup>[13]</sup> and group-based interventions for smartphone addiction<sup>[14]</sup> with promising results. However, there is a scarcity of well-designed randomized controlled in this area.

Exercise-based interventions<sup>[15]</sup> are gaining momentum due to greater applicability in controlling online time and enhancing the physical and emotional well-being of the participants.<sup>[16,17]</sup> However, this needs further exploration with multicentric cross-cultural trials.

While conventional psychological interventions such as CBT, mindfulness, and exercise-based interventions have been useful in managing excessive use of technology, complementary therapies such as yoga are becoming more and more popular as a supplement to conventional psychological interventions.<sup>[11,18]</sup> In a previous pilot study,<sup>[19]</sup> we introduced a brief integrated yoga program to 70 excessive Internet users, out of which 45 subjects reported a reduction in body pain and positive behavioral regulations of the lifestyle in terms of enhanced sleep, appetite, and communication with others, thereby resulting in 30%–40% reduction in technology use at the end of 3 months.

Overall, studies suggest that yoga as an adjunctive therapy can be a useful intervention for managing technology addiction and associated psychological and physical symptoms. The integrated yoga program<sup>[19]</sup> and multimodal psychotherapy program<sup>[20]</sup> have shown promising results in earlier studies. However, studies in this area are scarce, and there is a need for continued evidence generation. Hence this study aimed to investigate the clinical utility

of adjuvant yoga therapy with multimodal psychological intervention on Internet use severity (primary outcome variable) among participants with excessive technology use using a randomized controlled study design.

### Research question

How does the integration of yoga as an adjuvant treatment, combined with multimodal psychological intervention, influence the well-being and technology usage patterns of a diverse participant group with excessive technology use?

### Hypothesis

We hypothesised that incorporating yoga as adjuvant therapy, combined with multimodal psychological intervention, will demonstrate positive feasibility indicators, in terms of reduction in Internet use, smartphone use, Internet gaming, and psychological distress suggesting its potential effectiveness in addressing and mitigating excessive technology use among participants.

### Methods

#### Study design

This study used a two-arm randomized controlled prospective trial design with assessor blinding and allocation concealment.

#### Subjects

##### *Sample size estimation*

The sample size estimation was carried out based on the effect size of 0.63 obtained from our previous pilot study<sup>[16]</sup> for the variable s-IAT which is the primary outcome variable in the current trial. From this, our required sample size with  $\alpha = 0.05$  and power at 90% came out to be 15 participants in each group of intervention. Hence, for two groups, i.e. Group A (add-on yoga) and Group B (psychotherapy alone), the total sample size obtained was 30.

The randomization list was generated using a random number generating software using a 1:1 allocation ratio by an independent statistician. The list was shared with the Clinical Research Coordinator (CRC). Allocation sequence was generated using computer-generated random numbers, and allocation concealment was done using opaque, sealed envelopes. CRC prepared serially numbered, opaque, sealed envelopes using the randomization list.

#### Selection criteria

The subjects were recruited from a specialized treatment clinic providing help in the technology de-addiction. These were subjects who sought help to overcome the excessive use of technology that was hampering their socio-occupational functioning. Subjects were screened using s-IAT<sup>[7]</sup> and only those scoring above 36 on the scale were recruited. Clinical screening was done by

a psychiatrist using the Structured Clinical Interview for DSM-5 (SCID-5) to rule out severe psychiatric comorbidities. Subjects of both the genders, those in the age range of 15–40 years,<sup>[21]</sup> and those who had ability to speak, read, and write in English and/or Hindi languages were eligible. Subjects with a history of/or current medical illness that may significantly influence central nervous system function or structure (including intellectual disability, significant head injury, and seizure disorder) as judged by clinical interview; history of head injury resulting in loss of consciousness or neurosurgery; severe depression with suicidal ideations; pregnancy or postpartum; and those with psychosis and any other severe comorbid psychiatric disorder which made them uncooperative for assessment or intervention were excluded from the study.

### Ethical statement

The study was approved by the Institutional Research Ethics Committee with approval letter number NIMHANS/EC/BEH. Sc. DIV 22<sup>nd</sup> Meeting/0219. Subsequently, the trial was registered under the Clinical Trials Registry of India (CTRI) with registration number: CTRI/2021/12/049950. Informed consent and assent forms were taken from those who fulfilled the eligibility criteria, and the procedures of the therapy were explained to the participants. Funds for travel to the research and clinical center and reimbursement for the loss of earned wages were offered to all subjects participating in the study.

### Intervention

Group A participants received the yoga program and the multimodal psychotherapy intervention program and Group B received only the multimodal psychotherapy intervention program for 1 month, respectively, by certified mental health and yoga practitioners. This was followed by monthly booster (yoga + psychotherapy for Group A and psychotherapy alone for Group B) sessions and post-assessments conducted at 12 weeks. Both groups underwent a structured psychotherapy program for 8 sessions delivered by the same psychotherapist who was blind to the group allocation status of the subjects.

### The add-on yoga program

Group A also underwent an integrated yoga program that was designed specifically to reduce distress and severity of technology use. The program duration was 35 minutes (plus 10 minutes weekly philosophical discussion/trataka kriya). Table 1 provides the details of the Yoga module. This module was developed and validated before its clinical application as a part of the funded project (details available with the principal investigator). The module consisted of yoga loosening practices with breath synchronization interspersed with periods of *mukha dhauti* (washout breathing) after each practice. External retention of breath (*bahya kumbhaka*) was emphasized for enhancing the

mindfulness and self-awareness (as per Patanjali Yoga Sutra: 1.34). This was followed by fast *Kapalabhati Kriya* (skull shining breath) at 90–120 strokes/min for 2 min, *Bhastrika* at 20 strokes per cycle for 2 cycles, *Chandra anuloma villoma pranayama* (left nostril breathing) for 2 min, and *Bhramari* (humming breath) *pranayama* for 3 min and Om chanting with O and M in the ratio 1:3 for 3 min. Chanting was emphasized to bring limbic deactivation and enhance vagal tone. Yoga intervention was delivered by a trained yoga therapist in the team (SS). The therapist had MSc degree in yogic sciences. During initial 1 month, yoga sessions coincided with the psychotherapy sessions for the initial 8 sessions where yoga was offered before the psychotherapy session in Group A. To ensure that subjects learned the yoga properly, two more yoga sessions were offered in initial 1 month. After completing 10 sessions of supervised yoga, a yoga booklet was shared and subjects were asked to continue practicing the same (one session per day in an empty stomach condition ~2 h after food or 30 min before the next meal) for the next 8 weeks at home. Subjects were encouraged to practice yoga in the morning time before breakfast (or before lunch if they get up late), rather than in the evenings. Practices were checked and corrected during monthly booster sessions in the next 2 months.

### The multimodal psychotherapy program

The multimodal psychotherapy program included 8 sessions and components from evidence-based psychotherapeutic intervention programs for IGD such as motivational enhancement therapy, cognitive behavior therapy, and family therapy. Table 2 provides details about the psychotherapy program which was validated in a previous study on a similar population.<sup>[20]</sup> Monthly booster psychotherapy sessions were offered in the next 8 weeks which included monitoring progress and prevention of relapse.

### Assessments

The baseline was defined in the study as the time point before starting the intervention program. The post-intervention measurement point was kept after 12 weeks of starting the intervention program. Those who were absent for 3 consecutive sessions in any group were considered dropouts. Baseline assessments included case history evaluation interview, sociodemographic and clinical details' data sheet, screening measures, and outcome measures.

### Sociodemographic data sheet

The data sheet was prepared by the investigator which included details about sociodemographic variables such as age, sex, education, occupation, and family status. The data sheet also included questions on duration, frequency, mode of technology use, effect of technology use on daily life functioning, and offline time spent on activities.

**Table 1: Validated yoga module for Internet use disorder**

Practice (English)	Practice (Sanskrit)	Rounds	Time
Dynamic jogging	Sithilikarana vyayama	2	30 s
Yoga mouth washout breathing for 5 cycles followed by external retention of breath	Mukha Dhauti with bhahya kumbhaka)	5 rounds of mukha dhauti followed by 15 s of kumbhaka	30 s
Dynamic twisting with breath synchronization	Sithilikarana Vyayama	10	20 s
Dynamic forward-backward bend with breath synchronization	Sithilikarana Vyayama	10	20 s
Dynamic side bending with breath synchronization	Sithilikarana Vyayama	10	20 s
Yoga mouth washout breathing for 5 cycles followed by external retention of breath	Mukha Dhauti with bhahya kumbhaka	5 rounds of mukha dhauti followed by 15 s of kumbhaka	30 s
Instant relaxation technique (IRT)	Tatkal sithilikaran kriya	1	1 min
Sun salutations (10-step method)	Suryanamaskara	6 (3 rounds slow, 3 rounds fast)	7 min
Yoga mouth washout breathing for 5 cycles followed by external retention of breath	Mukha Dhauti with bhahya kumbhaka	5 rounds of mukha dhauti followed by 15 s of kumbhaka	30 s
Deep abdominal breathing with inhalation: exhalation=1:2 in shavasana	Gehan sithilikaran kriya	1	2 min
Shoulder stand inverted pose	Sarvangasana	1	1 min
Tree pose	Vrikshasana	1	1 min
Rabbit pose breathing with humming breath during exhalation	Shashankasana breathing with bhramari during exhalation	5 rounds with breath synchronization followed by maintenance for 30 s with bhramari	1 min
Sectional breathing in 3 mudras (inhale: hold: exhale: hold=4:16:8:4)	Vibhagiya pranayama, 3 rounds in each mudra - chin, chinmaya, adi	Ratio: 1:4:2:1 3×3 × 3=9 rounds	5 min
High-frequency skull-shining breath followed by external retention of breath for 15 s	Kapalabhati with bhahya kumbhaka	90–120 strokes/2 cycles with 15 s rest in between	3 min
Bellow breathing followed by external retention of breath for 15 s	Bhastrika with bhahya kumbhaka	20 strokes/2 rounds with 15 s rest in between	3 min
Left nostril breathing inhalation: exhalation=1:2	Chandra anuloma	10	2 min
Humming breathing with shanmukhi mudra with table support	Bhramari	6	3 min
Om chanting (O:M=1:3)	Pranava Japa	9 (1:2)	3 min
Focusing on a candle flame in a dark room till tears roll down the eyes (once a week)	Jyoti Trataka Kriya	1	10 min
Discussions from yoga philosophy perspective: Happy analysis ( <i>Ananda mimamsa</i> ) and inquiry into the nature of the “self” ( <i>Atma parikasha</i> )		Once a week for 10 min after the session	

**Table 2: Structure of the multimodal psychotherapy program**

Sessions	Type of intervention	Components	Stage of motivation
1 and 2	Rapport building, clinical intake, motivational interviewing, and psychoeducation	These sessions focus on bringing down the denial and resistance of the client	Precontemplation
3 and 4	Clinical intake, assessment, motivational interviewing, and psychoeducation	Brief MET, clinical data sheet information gathering, and assessments	Contemplation
5 and 6	Behavior therapy	Behavior activation and contingency management	Determination and action
6 and 7	Cognitive behavior therapy	Cognitive restructuring, healthy use of Internet skills, improving interpersonal relations, and initiating relapse prevention skills	Action
8	Relapse prevention	Consolidation of progress and reviewing the previous sessions	Action and maintenance
Booster sessions	Relapse prevention	Skills reinforcement, enhancing generalization, reviewing and adjusting new strategies to encounter new stressors	Maintenance

MET: Motivation enhancement therapy



### *Internet Addiction Test-Short Version<sup>[7]</sup>*

We used the s-IAT that was validated by Pawlikowski et al. (2013) to assess IA. The s-IAT consists of 12 items to be rated on a 5-point Likert scale ranging from 1 (rarely) to 5 (always). The s-IAT has good psychometric properties and represents the key diagnostic criteria of IA. The total score of the s-IAT ranges from 12 to 60 and represents an individual's tendency to or the degree of IA. We used the cutoff point of 36 to classify a participant as suffering from Internet addiction.<sup>[22]</sup>

### *Smartphone Addiction Scale-Short Version*

Smartphone Addiction Scale-Short Version (SAS-SV) contains 10 items, each score on a Likert scale of<sup>[23]</sup> 1 (strongly disagree) to 6 (strongly agree). The total scores were calculated by adding up all the scores given by the participants on each item, and the total score ranged from 10 to 60 with a cutoff point of 29. The Cronbach's coefficient in this study was 0.89.<sup>[24]</sup>

### *Internet Gaming Disorder Scale-Short Form*

The 9-item IGD Scale-Short Form (IGDS9-SF) assesses the severity of IGD and its detrimental effects over<sup>[25]</sup> a 12-month period.<sup>[26]</sup> The instrument has demonstrated good validity and reliability for assessing IGD.<sup>[27]</sup>

### *Kessler's Psychological Distress Scale*

The Kessler's Psychological Distress Scale (K6) is a measure of nonspecific psychological distress that<sup>[28]</sup> is utilized as a screening tool for serious mental illness in community-based samples (Cronbach's alpha = 0.83)<sup>[29]</sup> and verified to accurately discriminate cases of DSM-IV psychiatric disorders. Scale items are summed to achieve a final score, with higher scores on the K6 indicating higher levels of psychological distress.<sup>[30]</sup>

### **Statistical analysis**

The data were coded and analyzed using the Statistical Package for the Social Sciences (SPSS) Version 23.0 IBM Corp. IBM SPSS Statistics for Windows. (Armonk, NY: IBM Corp).<sup>[31]</sup> Normality tests were performed and nonparametric tests were performed for data that were not normally distributed. The significance level was set at  $P < 0.05$ .

At baseline, an independent samples *t*-test was applied between the two groups. To test the intervention effects, repeated measures analysis of covariance (RMANCOVA) was applied with a between-subject fixed-effects factor with two levels (add-on yoga and psychotherapy alone) and time as a within-subject fixed-effects factor with two levels (baseline and 12 weeks). The baseline scores of both groups served as input covariates. First, we tested whether the assumptions of the RMANCOVA were met for the scores of each item. If the interaction  $P > 0.05$  for group x prior scores, RMANCOVA was applied, and if  $P < 0.05$ , RMANCOVA was considered

unsuitable. Effect sizes were calculated using partial eta square for RMANCOVA, and *r* square was calculated for the Mann-Whitney U-test for non-normally distributed variables.

## **Results**

### **Subject demographics**

One person dropped out of the study (from the control arm) without providing any specific reason. Thus, 29 subjects completed the trial. The demographic characteristics of both groups are shown in Table 3. The mean age (in years) for Group A was 22.9± 6.5 and Group B was 22.5±5.7. The frequency of males in Group A was 12 and 10 and for females it was 3 and 4 respectively. The mean education for Group A was 14.1 ± 1.6 and 13.8 ± 1.7 for Group B, respectively. In addition, the mean age and education of the two groups were compared using an independent samples *t*-test, and the gender headcount percentages were compared using the  $\chi^2$  test. No significant differences were found. Therefore, random assignment confirmed that participants in both groups were homogeneous in their characteristics at baseline. The percentages of Groups A and B for education were 60% and 50% for graduation, 33.3% and 42.9% for 12<sup>th</sup> standard, and 6.7% and 7.1 for postgraduation, respectively. The percentages of Groups A and B for occupation were 66.7% and 71.4% for students and 33.3% and 28.6% for IT professionals, respectively.

### **Baseline and postintervention**

In order to understand the mean differences, group\*time intervention effects, and effect sizes, RMANCOVA was applied for normally distributed variables (S-IAT, SAS-SV, and K6). The Mann-Whitney U-test was applied to understand the mean rank differences and effect sizes for nonnormally distributed variables such as weekday use, weekend use, time spent on hobbies, and IGDS9-SF. Significant differences were found in s-IAT, SAS-SV, K6, and weekend use between the two groups ( $P < 0.05$ ), favoring Group A [Tables 4 and 5]. No significant differences were found between weekday use, time spent on hobbies, and IGDS9-SF.

### **Between-subject effects**

The RMANCOVA was conducted to examine changes in the scores from baseline to postintervention between the add-on yoga group (Group A) and psychotherapy alone group (Group B). Results on S-IAT which measures Internet addiction showed that the mean for baseline was  $\mu = 37.7$  (4.0) for Group A and  $\mu = 37.3$  (3.8) for Group B as the cutoff was 36, which reduced for postintervention to  $\mu = 23.6$  (2.4) for Group A and  $\mu = 34.8$  (2.2). The interaction was significant for both the groups on s-IAT,  $P = 0.02$  ( $P < 0.05$ ), with a small effect size ( $\eta_p^2 = 0.17$ ). Similarly results on SAS-SV which measures smartphone addiction showed a significant decrease in the mean in postintervention  $\mu = 28.6$  (6.1) for Group A and  $\mu = 32.9$  (5.2)

**Table 3: Demographic characteristics of the sample (n=29)**

Variable	Group A - add-on Yoga (n=15), frequency (%)	Group B - psychotherapy alone (n=14), frequency (%)	P
Age	22.9±6.5	22.5±5.7	0.87 <sup>a</sup>
Gender			
Male	12	10	0.59 <sup>b</sup>
Female	3	4	
Education	14.1±1.6	13.8±1.7	
12 <sup>th</sup> standard	5 (33.3)	6 (42.9)	0.66 <sup>a</sup>
Graduation	9 (60)	7 (50)	
Postgraduation	1 (6.7)	1 (7.1)	
Occupation			
Student	10 (66.7)	10 (71.4)	
IT professional	5 (33.3)	4 (28.6)	

<sup>a</sup>Independent samples *t*-test, <sup>b</sup>Chi-square test. IT: Information technology

**Table 4: Results of the evaluation of the effects before and after the intervention**

Measurements	Baseline, mean±SD		Postintervention, mean±SD		RMANCOVA		Effect size ( $\eta_p^2$ )
	Group A <sup>a</sup> (n=15)	Group B <sup>b</sup> (n=14)	Group A <sup>a</sup> (n=15)	Group B <sup>b</sup> (n=14)	F	P	
S-IAT	37.7±4.0	37.3±3.8	23.6±2.4	34.8±2.2	5.61	0.02*	0.17
SAS-SV	39.1±8.1	38.4±8.2	28.6±6.1	32.9±5.2	4.76	0.03*	0.15
K6	17.1±4.3	16.2±4.3	9.9±2.9	14.2±4.3	7.71	0.01*	0.22

\**P*<0.05, <sup>a</sup>Add-on yoga group, <sup>b</sup>Only psychotherapy alone group. s-IAT: Internet Addiction Test-Short Version, SAS-SV: Smartphone Addiction Scale-Short Version, K6: Kessler's Psychological Distress Scale, RMANCOVA: Repeated measures analysis of covariance, SD: Standard deviation

**Table 5: The differences in mean ranks on Mann-Whitney U-test**

Variable	Baseline, mean rank		Postintervention, mean rank		U	Z	P	Effect size ( $r^2$ )
	Group A <sup>a</sup> (n=15)	Group B <sup>b</sup> (n=14)	Group A <sup>a</sup> (n=15)	Group B <sup>b</sup> (n=14)				
Weekday	14.8	15.2	11.9	18.3	102.0	-0.13-2.1	0.91	0.15
					58.5			
Weekend	14.2	14.8	12.1	18.2	102.5	-0.11-2.0	0.91	
					60.0			
Hobbies	14.3	15.7	17.1	12.6	95.0	-0.46-1.5	0.68	
					72.0			
IGDS9-SF	14.6	15.3	14.5	15.6	100.0	-0.22-0.33	0.84	
					97.5			

\**P*<0.05, <sup>a</sup>Yoga + psychotherapy add-on yoga group, <sup>b</sup>Psychotherapy alone group. IGDS9-SF: Internet Gaming Disorder Scale-Short Form

for Group B as compared to baseline  $\mu = 39.1$  (8.1) and  $\mu = 38.4$  (8.2), respectively, with mean decreasing for Group A. The interaction effect showed significant differences between the groups  $\eta_p^2 = 0.03$  favoring Group A with a small effect size of 0.15. In addition, the scores of K6 which measures psychological distress showed significant differences on interaction effect between both the groups  $\eta_p^2 = 0.01$  favoring Group A with small effect size and mean difference of  $\mu = 17.1$  (4.3) and  $\mu = 16.2$  (4.3) to  $\mu = 9.9$  (2.9) and  $\mu = 14.2$  (4.3), respectively.

## Discussion

This study examined whether yoga as an adjuvant treatment reduces psychological and physical dysfunctions and severity of technology use better than psychotherapy alone using a randomized controlled design. We hypothesized that the

add-on yoga group will have lesser dysfunctions and severity of technology use as compared to the psychotherapy-alone group at the end of 12 weeks. We observed that adding yoga brought significant improvement in variables of Internet use severity, smartphone use, psychological distress and overall weekday usage, also further enhanced treatment adherence and retention to treatment at the end of 12 weeks. This is in line with previous preliminary literature that yoga helps in mitigating technology use related activity schedules and increases time spent on offline activities.<sup>[18]</sup> However, we did not find significant between-group differences for weekend use, time spent on hobbies, and Internet gaming. This may be explained based on a study which has shown that Internet gaming is a preferred activity of students for relieving stress, passing time, and competing with peers during weekends.<sup>[32]</sup>

Although CBT is by far the most researched and utilized treatment approach for excessive use of technology, other studies have discussed non-CBT treatments with promising results. Notably, researchers have used an online personalized feedback approach, acceptance and commitment therapy reality therapy, multimodal treatments without CBT components, and promotion of exercise routines.<sup>[33-35]</sup> Preliminary evidence from studies suggested that yoga may be useful in reducing stress/anxiety, depression, pain, and addiction (Cramer *et al.*, 2015).<sup>[36]</sup> Despite the preliminary positive results, yoga as a treatment for technology overuse has underexamined, and we could not come across any systematic trial that has explored the utility of add-on yoga intervention in this condition.

In the current study sample, we observed that there were more male subjects than females and more number of student population in the sample which is in line with previous literature on the prevalence of excessive use of technology and gender and affected productivity due to excessive technology use.<sup>[37]</sup> In a previous study, a multimodal psychotherapy program was developed from the need to have a comprehensive, integrated, and wholesome approach for the management of excessive use of technology.<sup>[20]</sup> However, there were high dropout rate and less homework compliance in the previous study. Most studies have reported less homework compliance and treatment adherence, especially for activity scheduling, management of time (offline and online), and physical activities.<sup>[38]</sup> In our study, we observed just one dropout at the end of 12 weeks. This may be due to the following reasons: (1) the study was performed in a community setup and subjects were recruited from a center for well-being rather than a proper clinical psychiatry setup, this would have reduced stigma, and thus, subjects were willing to report on a regular basis. Yoga itself is a discipline which has potential to treat disorders as well as enhance well-being and carries lesser stigma as compared to other psychiatric treatment modalities; (2) we offered reimbursement for travel and loss of earned wages which helped reduce financial burden due to the trial.

Technology provides a convenient way to address some needs. Overuse leads to problematic usage, which can be anticipated by psychological distress, according to studies.<sup>[39,40]</sup> According to self-determination theory, we all have a fundamental need for autonomy, competence, and relatedness. Some studies hypothesize that people who experience psychological distress because their basic needs are not being met are more likely to become dependent on the technology when they turn to online activities to satisfy those needs.<sup>[41,42]</sup> Psychotherapy and yoga may work by increasing self-motivation and determination, hence we found a decrease in smartphone, Internet use, and psychological distress. In addition, yoga may produce its effects by enhancing “self-awareness” and “sense of connectedness.” Studies have also shown that

regular practice of yoga may enhance neuroplasticity (by increasing brain-derived neurotrophic factor) and reduce psychological stress (by downregulating the hypothalamic–pituitary–adrenal axis and thereby reducing serum cortisol levels). Yoga and psychotherapy may have synergistic effects where one may enhance the quality and receptivity of another. All this may translate into enhanced “cognitive flexibility” by yoga and multimodal psychotherapy interventions as compared to psychotherapy alone. Future studies should explore these underlying interactions and biological mechanisms. The findings of this study carry important implications for the clinical care of patients with excessive use of the Internet. Since yoga is such a modality of intervention which empowers the person who practices it and can easily be incorporated into lifestyle. Patients with technology addiction may feel empowered by these simple mind-body tools of yoga and may be able to use them. Mobile apps could be developed using these simple yogic techniques to counter technology addiction with the help of technology itself. This way an individual takes charge of his own health. Yoga also enhances self-awareness and mindfulness; thus, it may be possible that with continued use of yoga subjects may develop greater cognitive flexibility, control over impulsive behaviour and enhanced ability for self-regulation. This needs to be tested in future trials to establish possible psychological mechanisms through which yoga may work.

Major limitations of the current study are (1) lack of active control group: we could have added an attentional control group (for example, health education along with psychotherapy in the control arm) to match the number of therapist interactions, but this was not feasible in the current trial due to logistic limitations; (2) the current study is still a short duration study and we still cannot comment on long-term adherence; and (3) underlying biological mechanisms were not explored. Future studies with larger sample sizes, multicenter approach, and longer intervention periods should be planned to further explore the potential of yoga as an adjuvant to multimodal psychological interventions for technology addiction. Although it is still premature to conclude based on limited evidence, considering the potential of adding yoga to psychotherapy in the current study, yoga + CBT can be a new dimension for future trials in the area of excessive Internet use.

## Conclusion

We found that adding yoga to multimodal psychotherapy was not only feasible but was effective in reducing symptoms and severity of technology addiction in young adult subjects with excessive technology and Internet use. Subjects adhered to the treatment at the end of 12 weeks and reported sustained improvements without deterioration at any point of time. Future trails should assess the long-term impact of add-on yoga intervention and possible underlying mechanisms.

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## Conflicts of interest

There are no conflicts of interest.

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