

Effects of Yogic Practice on Oxidative Stress-Antioxidant Levels in Persons with Mental Health Disorders

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Abstract –

Background: Mental health disorders may lead to oxidative stress and increased the risk for other disease which may be controlled by yoga.

Objectives: This study was performed to observe the influence of yogic practice on oxidative stress-antioxidant levels in persons with mental health disorders.

Methods: A total of four hundred thirty (n = 430) adult male volunteers (age: 21–50 years) screened, and were grouped into (a) mental health disorders group (MHDG, n = 230) and control group (CG, n= 200); 80 from MHDG and 50 from CG were excluded. The remaining 150 volunteers of MHDG and 150 volunteers of CG spited up: (i) 21-30 yrs (Category-I) (n = 50), (ii) 31-40 yrs (Category-II) (n = 50), and (iii) 41-50 yrs (Category-III) (n=50). The MHDG followed a yoga training of 60 min/day, 5 days/week for 12 weeks; yogic practice was prohibited in CG. Oxidative stress biomarkers and antioxidant levels were assessed in both the groups at the beginning (0-week) and after 12-weeks of intervention.

Results: A lower level of MDA; and higher in SOD, CAT, GPx, vit E and vit C levels were noted among the subjects of MHDG following 12 weeks of yoga training when compared to base line (0 week). Further, significantly higher level of MDA, lower level of SOD, CAT, GPx, vitamin E and vitamin C were observed among the subjects of MHDG when compared to CG at the beginning (0 week) and after 12 weeks of the study. In addition, age wise difference in MDA, SOD, CAT, GPx, vitamin E and vitamin C was also observed among the subjects of mental health disorder group and control group.

Conclusion: Regular practice of yoga improves the oxidative stress-antioxidant levels and reduced the risk of various diseases among the persons with mental health disorders.

Keywords – Mental Health Disorders, Oxidative Stress, Antioxidant, Yoga

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INTRODUCTION

The body's reaction to physical or emotional demands is known as stress. Any chemical or biological agent, environmental condition, external stimulus or an event seen may evoke stress reaction. Emotional discomfort may cause depression. The emotional discomfort may lead to feelings of sadness, which can make dealing with

tension more complicated. Depression may be triggered by high-stress situations like upset in work or ending a long-term relationship. Not everyone who is confronted with these circumstances gets sad. Biological factors may explain why one person develops depression while another does not when confronted with a stressful situation. Stress is good for fitness, the body is aware, empowered and prepared to respond to a challenge. Stress mobilizes the body to adjust to

improve outcomes, much like everyone knows who has reached a working time or has played a sport. However, too much tension or chronic stress may contribute to extreme depression in people who are losing the challenge. Mental health disorders are type of disorders which affect mood, behaviour, feeling, cognitive aspect and personality [1]. There are many categories of mental illness which include: anxiety disorders, depression, eating disorders, personality disorders, post-traumatic stress disorder and psychotic disorders [2]. The causes including stress, genetics, changes in neurotransmitters in brain, traumatic brain injury, nutritional deficiency, alcohol or drugs abuse, disease such as cancer, isolation, and exposure to environmental hazards [1, 2]. People from different age and gender have experienced mental health concern at different times. However, the mental health concern becomes mental health disorders when frequent onset of the signs and symptoms appears which may affect performance, mood, behaviour cognitive aspect and personality [3, 4]. The mental health disorders can also affect normal functions of different body systems including bodies oxidative and antioxidant defence mechanisms [1-3].

Oxidative stress is caused by increase level of H_2O_2 , O^- , HO^- and reduced antioxidant activities in the body. Free radicals contain oxygen molecules are also known as reactive oxygen species (ROS). They can react with other molecules because of uneven number. Free radicals are highly reactive and can damage to cell and tissues which is known as oxidative stress (OS) [4]. The product of free radicals is a normal process in aerobic metabolism and ROS perform a number of physiological places in cellular signalling and in the defence against pathogens. The ROS cause damage to DNA and proteins in the body and may lead to various diseases including diabetes, atherosclerosis, inflammatory conditions, hypertension, neurodegenerative diseases cancer and early aging [5, 6]. The antioxidants stabilize the free radical and thus are part of defense mechanism [7- 9]. The antioxidants are synthesized in the body and also originate in natural products fruits, vegetables etc. Antioxidants are grouped into enzymatic and non-enzymatic antioxidants (phytochemicals and vitamins). Enzymatic and non-enzymatic antioxidants are inter-dependent and work together. The enzymatic antioxidants like superoxide dismutase (SOD) [10], glutathione peroxidase (GPx) [11] and catalases (CAT) [12] are macromolecules and are synthesized in the body. The natural antioxidants are classified as phytochemicals and vitamins (vitamin E and vitamin C) are relatively smaller organic molecules with low molecular weights [13, 14]. Antioxidants by its defense mechanism provide protection against oxidative damage and thus prevent early ageing and chronic diseases, and may have some role in the etiology of depression [15]. People with depression symptoms have high level OS and low antioxidants. The oxidative stress can be indicated by assessment of

malonyldialdehyde (MDA), 8-hydroxydeoxyguanosine etc. It was found that elevation in OS observed in mental illness, including depression [8]. According to some studies, the antioxidant enzymes conditioning in cases with depression are different from those observed in healthy individualities [16]. Indeed, antioxidant enzymes conditioning are dropped in cases with depression [17]. Decline in SOD, GPx, and CAT, and rise in MDA was observed among cases with affective diseases [18].

Yoga started from India has various sub-types, and includes asana, pranayama and meditation, that is said to have positive impact on the body, mind and emotional well-beings [19]. Regular practice of yogic asanas, pranayama and meditation, the special techniques of yoga, improves physical fitness, self-regulation and mind-body awareness, this may have impact on health, mental state, behaviour and performance [19, 20]. Practicing meditation may improve the mind and body coordination; which is essential for positive behavioural outcomes [21]. Regular yoga activities may also increase the immunity within the body and thus have beneficial health effects. It has been reported that regular yoga can lower the chances of cardiovascular disease risk [21]. It was found that yogic practice increased cognitive functions, improved memory, sleep and quality of life of subjects having mental health disorders [22, 23]. This investigation focuses the effects of yogic practice on changes in OS and antioxidant levels in persons with mental health disorders.

MATERIALS AND METHODS

Subjects:

A total of four hundred thirty (n = 430) adult male volunteers (age: 21–50 years) screened, and were grouped into (a) mental health disorders group (MHDG, n = 230) and control group (CG, n= 200); 80 from MHDG and 50 from CG were excluded. The remaining 150 volunteers of MHDG and 150 volunteers of CG spited up: (i) 21-30 yrs (Category-I) (n = 50), (ii) 31-40 yrs (Category-II) (n = 50), and (iii) 41-50 yrs (Category-III) (n=50). The height and body mass of the subjects were measure. Control group [height (cm) 21-30 yrs- 162.22 ± 4.02, 31-40 yrs- 160. 17 ± 4.60, 41-50 yrs- 162.42 ± 4.39] ; mental health disorders group [height (cm) 21-30 yrs-161.28 ± 3.35, 31-40 yrs-162. 05 ± 4.24, 41-50 yrs-161.88 ± 4.06]. [body mass (kg) 21-30 yrs-61.75 ± 3.32, 31-40 yrs-63.03 ± 3.15, 41-50 yrs-63.34 ± 3.46]; mental health disorders group [body mass (kg) 21-30 yrs-64.66 ± 3.82, 31-40 yrs-67.56 ± 3.68, 41-50 yrs-67.63 ± 4.00]. This investigation has been conducted by the Department of Physiology, CMJ University, Jorabat, Meghalaya, India in collaboration with Department of Community Medicine, Midnapore Medical College;

and Department of Physiology, Midnapore College (Autonomous), Midnapore, West Bengal, India.

Inclusion criteria:

Subjects between 21–50 years, having mental health disorders were screened from the Midnapore District, West Bengal, India. The volunteers of MHDG were diagnosed by psychiatrist on the basis of the DASS-21 [24]. The volunteers of MHDG were free from clinical morbidities, and able to cooperate in tests. For the control group (CG) - normal healthy individuals between 21–50 years who were free from mental health disorders were considered eligible for this study.

Exclusion criteria:

Participants of MHDG were kept out when (i) age more than 50 years, (ii) history of substance use disorder, (iii) Hypertension for last 90 days and (iii) medical or surgical conditions which may hinder the tests e.g. inflammatory disease and recent fracture, past history of lower back problems, metastatic diseases. The exclusion criteria for CG volunteers were (i) age more than 50 years, (ii) history of substance use disorder, (iii) history of hypertension.

Ethical considerations:

The purpose and the possible complications of the study were clearly explained to all participants, parent/legal guardian, and written consent was obtained. The participants were asked to keep their traditional diet and refrain from smoking and alcohol throughout the experiment. The Research Committee of the Institutional provides necessary permission.

Yoga training:

All the volunteers were asked to join 02 weeks before the experiment for acclimatization. The experiment was conducted for 12 weeks. Yogic practice has been followed among the subjects of MHDG, while the subjects of CG have been restricted from yogic practice and allowed for recreational activities. Well qualified yoga instructors were engaged for yoga training. The yoga practice was performed for 60 min/day, 05 days/week for 12-weeks [25] (Table 1). At first the volunteers participated in prayer, Om chanting and Gayatri mantra for five minutes. Then the volunteers performed Yogic Sukshn Vyayam for ten minutes, which includes flexibility and movements of different body parts followed by Surya Namaskar for ten minutes. After Surya Namaskar the volunteers were engaged in Yogasana for fifteen minutes, which include Balasana, Halasana, Adho Mukha Svanasana, Urdhva Mukha Svanasana, Setu Bandhasana, Vrikshasana, Anjaneyasana and Shavasana. Then the subjects performed Pranayama for ten minutes which include Bhramari

Pranayama and Nadi Shodhan Pranayama. Next the volunteers were engaged in Meditation for five minutes, which was followed by Ajpa Jap and Shanti Mantra for another five minutes. The total duration of the yoga training was for sixty minutes.

Table 1: Routine of yogic practice

Yogic Practice	Time (min)
Prayer	
Om chanting	05
Gayatri Mantra	
Yogic Sukshn Vyayam	10
Surya Namaskar	10
Yogasana	
Balasana	
Halasana	
Adho Mukha Svanasana	
Urdhva Mukha Svanasana	15
Setu Bandhasana	
Vrikshasana	
Anjaneyasana	
(viii) Shavasana	
Pranayama	
Bhramari Pranayama	10
Nadi Shodhan Pranayama	
Meditation	05
Ajpa Jap	05
Shanti Mantra	
Total	60

Experimental Design:

The study was carried out in two phases. In the first phase, the level of stress and OS and antioxidant levels were assessed at the beginning of the study (0 week). In the second phase, volunteers of MHDG performed yogic practice for twelve weeks but no such yoga training was suggested for the subjects of CG. The level of stress and OS and antioxidant levels were assessed again after the twelve weeks in both the groups. The MHDG participants were informed not to involve in any other physical activity during the entire period of intervention. The subjects of CG were allowed for recreational activities and were asked to follow the same throughout the period of the study (Figure 1).

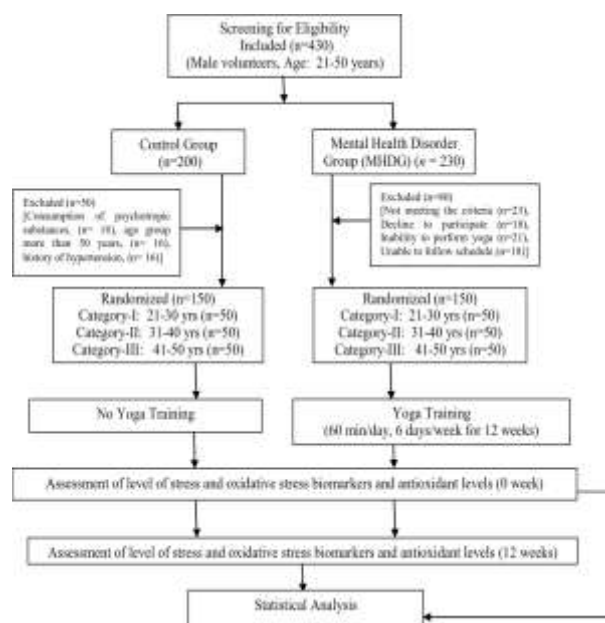


Fig 1: Consort flow chart

Collection of blood sample:

Blood samples were obtained from antecubital vein using sterile needle and syringe (Disproven, 5 ml) with full aseptic precautions for each instance. A 5.0 ml blood was collected from each volunteer using plain bulb. The plasma and serum were separated by centrifugation at room temperature and were analyzed on the same day of collection.

Determination of malondialdehyde (MDA)

The oxidant-antioxidant defence mechanism was determined by spectrophotometric process. Lipid peroxide as indicated by MDA was determined by spectrophotometric method [26]. The three carbon dialdehyde, which are generated by lipid hydroperoxidation, were extremely reactive malonyldialdehyde (MDA). TBA was used to estimate MDA. Serum samples were first processed in protein precipitation using TCA and TBA. The chromogen produced was centrifuged and supernatant colour intensity was colorimetrically evaluated at 530 nm and was expressed as nmol/ml.

Determination of serum superoxide dismutase (SOD)

The activity of serum SOD was assessed by spectrophotometric process [27]. Pyrogallol autoxidises quickly and this was used to estimate the dismutase superoxide. A fast and easy technique for determining the enzyme was superoxide dismutase (SOD). The reading was made at an accurate speed of 420 nm after 1 minute and after 30 seconds and 3 minutes and 30 seconds. The level of SOD was expressed in units/ml.

Determination of blood catalase (CAT) activity

The activity of blood catalase was assessed by spectrophotometric process [28]. Hydrogen peroxide (H₂O₂) showed elevated absorption with reducing wavelength. The decomposition of hydrogen peroxide can be followed directly by decrease in extinction at 285 nm. The level of catalase was expressed in k/gm Hb.

Determination of serum glutathione peroxidase (GPx)

The activity of blood GPx was assessed by spectrophotometric process [29]. The test utilised includes combining the level of GPx to reduce glutathione (GR). The process was triggered by H₂O₂ added to H₂O by decreased glutathione (GSH) and glutathione peroxidase activity. The resulting GSSG was reduced by NADPH and glutathione reductase back to GSH. Average change in absorption was computed each minute at 340 nm.

Determination of serum vitamin E

The concentration Vitamin E (alpha tocopherol) was assessed by standard process [30]. Vitamin E was estimated by change of Fe³⁺ to Fe²⁺ form, and form a colour complex with α - α' dipyridyl, and was assessed at 520 nm. The serum Vitamin E (alpha tocopherol) was expressed by mg/dl.

Determination of plasma vitamin C

The concentration Vitamin C (ascorbic acid) in plasma sample was estimated by standard method [31]. The ascorbic acid was oxidized to diketogulonic acid in presence of strong acid solution and the diketogulonic acid reacts with 2,4 dinitro phenyl hydrazine to form dinitrophenylhydrazone and react with H₂SO₄ to produce red colored complex which can be measured colorimetrically at 500 nm and was expressed by mg/dl.

Statistical Analysis

All the statistical analysis was performed by statistical software package (SSPSS20 Windows, IBM, USA). The Shapiro–Wilk normality test was conducted to check whether the data were normally distributed [32]. Descriptive statistics including the mean and standard deviation were computed [33]. To observe the differences in within group and between group variables Two-way ANOVA and Bonferroni test was applied [33]. The level of significant was chosen at $P \leq 0.05$.

RESULTS

Influence of yogic practice on malonyldialdehyde (MDA) levels

It was found that the MDA level reduced significantly at end of the study among the subjects of MHDG when compared to base line (0 week). Further, increased in MDA level was noted among the subjects of MHDG than CG at the beginning (0 week) and end of the study (12 weeks). In addition, age wise difference in MDA level was observed among the subjects of MHDG and CG (Table – 2).

Table 2: Two-Way ANOVA and Descriptive Statistics for Malonyldialdehyde (MDA) of Control Group and Mental Health Disorder Group subjects of Different Age before (0 week) and after (12 weeks) the intervention

Age Groups	Malonyldialdehyde (MDA) (nmol/ml)				Two-way ANOVA		
	Control Group		Mental Health Disorder Group		F	P-value	F crit
	0 wk	12 wks	0 wk	12 wks			
21-30 yrs (CAT-I)	5.18 ± 0.42	5.09 ^{NS} ± 0.37	9.88 ^{***} ± 1.29	7.30 ^{****} ± 1.27	443.18	9.62	2.23
31-40 yrs (CAT-II)	5.39 ^{NS} ± 0.82	5.25 ^{NS} ± 0.70	10.42 ^{***} ± 1.34	7.74 ^{****} ± 1.08	350.00	1.26	3.86
41-50 yrs (CAT-III)	5.77 ^{NS} ± 0.43	5.68 ^{NS} ± 0.57	11.44 ^{****} ± 1.54	7.96 ^{****} ± 1.07	62.85	1.71	2.23

Data presented as mean and SD; n=50; Two-way ANOVA and Bonferroni test was applied; Computed using alpha = 0.05; Confidence Interval = 95%; Data were significantly different from each other when compared between [before (0 wk) and after (12 wks) the intervention (level of significance ^{***}P<0.001, ^{**}P<0.010, ^{*}P<0.050)]; Control Group and Mental Health Disorder Group (level of significance ^{###}P<0.001, ^{##}P<0.010, [#]P<0.050); CAT-I (level of significance ^{\$\$\$}P<0.001, ^{\$\$}P<0.010, ^{\$}P<0.050); CAT-II (level of significance ^{ψψψ}P<0.001, ^{ψψ}P<0.010, ^ψP<0.050)]; NS= non significance. F value (F), F critical value (F crit), probability value (P-value).

It has been noted that the MDA decreased by 26.11%, 25.72% and 30.421% respectively for CAT-I, CAT-II and CAT-III subjects of MHDG following yogic practice when compared to base line (0 week). The MHDG had 90.73%, 93.32% and 98.27% higher MDA respectively for CAT-I, CAT-II and CAT-III subjects at the beginning (0 week) of the study than CG. Moreover, the MHDG showed 43.42%, 47.43% and 40.14% greater MDA respectively for CAT-I, CAT-II and CAT-III subjects than CG after the end of the study (12 weeks).

Influence of yogic practice on superoxide dismutase (SOD) levels

It was found that the SOD level increased significantly at end of the study among the subjects of MHDG when compared to base line (0 week). Further, lower level of SOD was noted among the subjects of MHDG when than CG at the beginning (0 week) and end of the study (12 weeks). In addition, age wise difference in SOD level was observed among the subjects of MHDG and CG (Table – 3). It has been noted that the SOD increased by 21.46%, 26.42% and 30.34% respectively for CAT-I, CAT-II and CAT-III subjects of MHDG following yogic practice when compared to base line (0 week). The MHDG had 29.84%, 32.97% and 32.37% lower SOD respectively for CAT-I, CAT-II and CAT-III subjects than CG at the beginning (0 week) of the study. Moreover, the MHDG showed 16.14%, 15.95% and 13.11% lower SOD respectively for CAT-I, CAT-II

and CAT-III subjects than CG after the end of the intervention (12 weeks).

Table 3: Two-Way ANOVA and Descriptive Statistics for Superoxide Dismutase (SOD) of Control Group and Mental Health Disorder Group subjects of Different Age before (0 week) and after (12 weeks) the intervention

Age Groups	Superoxide Dismutase (SOD) (U/ml)				Two-way ANOVA		
	Control Group		Mental Health Disorder Group		F	P-value	F crit
	0 wk	12 wks	0 wk	12 wks			
21-30 yrs (CAT-I)	3.72 ± 0.15	3.78 ^{NS} ± 0.14	2.61 ^{***} ± 0.64	3.17 ^{****} ± 0.26	236.69	3.20	2.23
31-40 yrs (CAT-II)	3.67 ^{NS} ± 0.22	3.70 ^{NS} ± 0.22	2.46 ^{***} ± 0.46	3.11 ^{****} ± 0.30	182.84	1.81	3.86
31-40 yrs (CAT-II)	3.67 ^{NS} ± 0.22	3.70 ^{NS} ± 0.22	2.46 ^{***} ± 0.46	3.11 ^{****} ± 0.30	182.84	1.81	3.86
41-50 yrs (CAT-III)	3.46 ^{NS} ± 0.10	3.51 ^{NS} ± 0.08	2.34 ^{***} ± 0.34	3.05 ^{****} ± 0.32	28.19	1.21	2.23

Data presented as mean and SD; n=50; Two-way ANOVA and Bonferroni test was applied; Computed using alpha = 0.05; Confidence Interval = 95%; Data were significantly different from each other when compared between [before (0 wk) and after (12 wks) the intervention (level of significance ^{***}P<0.001, ^{**}P<0.010, ^{*}P<0.050)]; Control Group and Mental Health Disorder Group (level of significance ^{###}P<0.001, ^{##}P<0.010, [#]P<0.050); CAT-I (level of significance ^{\$\$\$}P<0.001, ^{\$\$}P<0.010, ^{\$}P<0.050); CAT-II (level of significance ^{ψψψ}P<0.001, ^{ψψ}P<0.010, ^ψP<0.050)]; NS= non significance. F value (F), F critical value (F crit), probability value (P-value).

Table 4: Two-Way ANOVA and Descriptive Statistics for Catalase (CAT) of Control Group and Mental Health Disorder Group subjects of Different Age before (0 week) and after (12 weeks) the intervention

Age Groups	Catalase (CAT) (k/gm Hb)				Two-way ANOVA		
	Control Group		Mental Health Disorder Group		F	P-value	F crit
	0 wk	12 wks	0 wk	12 wks			
21-30 yrs (CAT-I)	290.72 ± 8.75	293.78 ^{NS} ± 7.33	249.90 ^{***} ± 8.84	271.68 ^{****} ± 7.83	262.31	4.12	2.23
31-40 yrs (CAT-II)	283.92 ^{NS} 7.02	285.22 ^{NS} ± 6.32	236.81 ^{****} ± 7.54	266.93 ^{****} ± 8.90	209.45	7.98	3.86
41-50 yrs (CAT-III)	279.76 ^{NS} ± 5.36	282.38 ^{NS} ± 5.37	228.78 ^{****} ± 9.40	256.89 ^{****} ± 7.78	30.84	6.75	2.23

Data presented as mean and SD; n=50; Two-way ANOVA and Bonferroni test was applied; Computed using alpha = 0.05; Confidence Interval = 95%; Data were significantly different from each other when compared between [before (0 wk) and after (12 wks) the intervention (level of significance ^{***}P<0.001, ^{**}P<0.010, ^{*}P<0.050)]; Control Group and Mental Health Disorder Group (level of significance ^{###}P<0.001, ^{##}P<0.010, [#]P<0.050); CAT-I (level of significance ^{\$\$\$}P<0.001, ^{\$\$}P<0.010,

[§]P<0.050); CAT-II (level of significance ^{ΨΨ}P<0.001, ^{ΨΨ}P<0.010, ^ΨP<0.050)]; NS= non significance. F value (F), F critical value (F crit), probability value (P-value).

Influence of yogic practice on catalase (CAT) levels

It was found that the catalase level increased significantly at end of the study among the subjects of MHDG when compared to base line (0 week). Further, significantly lower catalase level was noted among the subjects of MHDG when than CG at the beginning (0 week) and end of the study (12 weeks). In addition, age wise difference in catalase level was observed among the subjects of MHDG and CG (Table – 4). It has been noted that the catalase (CAT) decreased by 8.72%, 12.72% and 12.29% respectively for CAT-I, CAT-II and CAT-III subjects of mental health disorder group after yogic practice when compared to base line (0 week). The MHDG had 14.04%, 16.59% and 18.22% higher catalase (CAT) respectively for CAT-I, CAT-II and CAT-III subjects than CG at the beginning (0 week) of the study. Moreover, the MHDG showed 7.52%, 6.41% and 9.03% greater catalase (CAT) respectively for CAT-I, CAT-II and CAT-III subjects than CG after the end of the intervention (12 weeks).

Table 5: Two-Way ANOVA and Descriptive Statistics for Glutathione Peroxidase (GPx) of Control Group and Mental Health Disorder Group subjects of Different Age before (0 week) and after (12 weeks) the intervention

Age Groups	Glutathione Peroxidase (GPx) (U/gm of Hb)				Two-way ANOVA		
	Control Group		Mental Health Disorder Group		F	P-value	F crit
	0 wk	12 wks	0 wk	12 wks			
21-30 yrs (CAT-I)	11.74 ± 0.79	11.86 ^{NS} ± 0.81	6.72 ^{***} ± 0.68	8.54 ^{****} ± 0.72	502.91	1.19	2.23
31-40 yrs (CAT-II)	11.03 ^{###} ± 0.87	11.18 ^{###} ± 0.75	6.23 ^{****} ± 0.73	8.26 ^{****} ± 0.79	202.22	1.18	3.86
41-50 yrs (CAT-III)	10.26 ^{###} ± 0.99	10.56 ^{###} ± 0.84	5.80 ^{****} ± 0.91	8.08 ^{****} ± 0.93	28.58	5.67	2.23

Data presented as mean and SD; n=50; Two-way ANOVA and Bonferroni test was applied; Computed using alpha = 0.05; Confidence Interval = 95%; Data were significantly different from each other when compared between [before (0 wk) and after (12 wks) the intervention (level of significance ^{***}P<0.001, ^{**}P<0.010, ^{*}P<0.050); Control Group and Mental Health Disorder Group (level of significance ^{###}P<0.001, ^{##}P<0.010, [#]P<0.050); CAT-I (level of significance ^{\$\$\$}P<0.001, ^{\$\$}P<0.010, ^{\$}P<0.050); CAT-II (level of significance ^{ΨΨ}P<0.001, ^{ΨΨ}P<0.010, ^ΨP<0.050)]; NS= non significance. F value (F), F critical value (F crit), probability value (P-value).

Influence of yogic practice on glutathione peroxidase (GPx) level

It was found that the GPx level increased significantly at end of the study among the subjects of MHDG when compared to base line (0 week). Further, significantly lower level of GPx was noted among the subjects of MHDG when than CG at the beginning (0 week) and end of the study (12 weeks). In addition, age wise difference in GPx level was also observed among the subjects of MHDG and CG (Table – 5). It has been noted that the GPx decreased by 27.08%, 32.58% and 39.31% respectively for CAT-I, CAT-II and CAT-III subjects of MHDG following yogic practice when compared to base line (0 week). The MHDG had 42.76%, 43.52% and 43.47% higher GPx respectively for CAT-I, CAT-II and CAT-III subjects than CG at the beginning (0 week) of the study. Moreover, the MHDG showed 27.99%, 26.12% and 23.48% greater GPx respectively for CAT-I, CAT-II and CAT-III subjects than CG after the end of the intervention (12 weeks).

Table 6: Two-Way ANOVA and Descriptive Statistics for Vitamin E (alpha-tocopherol) of Control Group and Mental Health Disorder Group subjects of Different Age before (0 week) and after (12 weeks) the intervention

Age Groups	Vitamin E (alpha-tocopherol) (mg/dl)				Two-way ANOVA		
	Control Group		Mental Health Disorder Group		F	P-value	F crit
	0 wk	12 wks	0 wk	12 wks			
21-30 yrs (CAT-I)	1.58 ± 0.10	1.60 ^{NS} ± 0.10	1.20 ^{***} ± 0.22	1.43 ^{****} ± 0.22	132.12	1.04	2.23
31-40 yrs (CAT-II)	1.52 ^{##} ± 0.03	1.54 ^{##} ± 0.05	1.12 ^{***} ± 0.18	1.36 ^{****} ± 0.21	124.11	2.76	3.86
41-50 yrs (CAT-III)	1.49 ^{###} ± 0.05	1.51 ^{###} ± 0.06	1.07 ^{***} ± 0.11	1.31 ^{****} ± 0.20	19.20	1.02	2.23

Data presented as mean and SD; n=50; Two-way ANOVA and Bonferroni test was applied; Computed using alpha = 0.05; Confidence Interval = 95%; Data were significantly different from each other when compared between [before (0 wk) and after (12 wks) the intervention (level of significance ^{***}P<0.001, ^{**}P<0.010, ^{*}P<0.050); Control Group and Mental Health Disorder Group (level of significance ^{###}P<0.001, ^{##}P<0.010, [#]P<0.050); CAT-I (level of significance ^{\$\$\$}P<0.001, ^{\$\$}P<0.010, ^{\$}P<0.050); CAT-II (level of significance ^{ΨΨ}P<0.001, ^{ΨΨ}P<0.010, ^ΨP<0.050)]; NS= non significance. F value (F), F critical value (F crit), probability value (P-value).

Influence of yogic practice on vitamin E (alpha-tocopherol) levels

It was found that the vitamin E level increased significantly at end of the study among the subjects of MHDG when compared to base line (0 week).

Further, significantly lower level of vitamin E was noted among the subjects of MHDG when than CG at the beginning (0 week) and end of the study (12 weeks). In addition, age wise difference in vitamin E level was observed among the subjects of MHDG and CG (Table – 6). It has been noted that the vitamin E levels increased by 19.17%, 23.21% and 22.43% respectively for CAT-I, CAT-II and CAT-III subjects of MHDG following yogic practice when compared to base line (0 week). The MHDG had 24.05%, 26.32% and 28.19% lower vitamin E levels respectively for CAT-I, CAT-II and CAT-III subjects than CG at the beginning (0 week) of the study. Moreover, the MHDG showed 10.63%, 10.39% and 13.25% lower vitamin E levels respectively for CAT-I, CAT-II and CAT-III subjects than CG after the end of the intervention (12 weeks).

Table 7: Two-Way ANOVA and Descriptive Statistics for vitamin C (ascorbic acid) of Control Group and Mental Health Disorder Group subjects of Different Age before (0 week) and after (12 weeks) the intervention

Age Groups	Vitamin C (ascorbic acid)				Two-way ANOVA		
	Control Group		Mental Health Disorder Group		F	P-value	F crit
	0 wk	12 wks	0 wk	12 wks			
21-30 yrs (CAT-I)	1.79 ± 0.09	1.80 ^{NS} ± 0.09	1.26 ^{***} ± 0.24	1.49 ^{****} ± 0.19	236.76	3.04	2.23
31-40 yrs (CAT-II)	1.74 ^{NS} ± 0.11	1.76 ^{NS} ± 0.11	1.20 ^{***} ± 0.22	1.42 ^{****} ± 0.21	87.17	2.02	3.86
41-50 yrs (CAT-III)	1.68 ^{NS} ± 0.10	1.70 ^{NS} ± 0.10	1.12 ^{****} ± 0.10	1.36 ^{****} ± 0.21	13.40	2.19	2.23

Data presented as mean and SD; n=50; Two-way ANOVA and Bonferroni test was applied; Computed using alpha = 0.05; Confidence Interval = 95%; Data were significantly different from each other when compared between [before (0 wk) and after (12 wks) the intervention (level of significance ^{***}P<0.001, ^{**}P<0.010, ^{*}P<0.050); Control Group and Mental Health Disorder Group (level of significance ^{****}P<0.001, ^{***}P<0.010, ^{**}P<0.050); CAT-I (level of significance ^{\$\$\$}P<0.001, ^{\$\$}P<0.010, ^{\$}P<0.050); CAT-II (level of significance ^{ΨΨΨ}P<0.001, ^{ΨΨ}P<0.010, ^ΨP<0.050)]; NS= non significance. F value (F), F critical value (F crit), probability value (P-value).

Influence of yogic practice on vitamin C (ascorbic acid) levels

It was noted that the vitamin C level increased significantly at end of the study among the subjects of MHDG when compared to base line (0 week). Further, significantly lower level of vitamin C was noted among the subjects of MHDG when than CG at the beginning (0 week) and end of the study (12 weeks). In addition, age wise difference in vitamin C level was also observed among the subjects of MHDG and CG (Table – 7). It has been noted that the vitamin C levels increased by 18.25 %, 18.33%

and 21.43% respectively for CAT-I, CAT-II and CAT-III subjects of MHDG following yogic practice when compared to base line (0 week). The MHDG had 29.61%, 31.03% and 33.33% lower vitamin C levels respectively for CAT-I, CAT-II and CAT-III subjects than CG at the beginning (0 week) of the study. Moreover, the MHDG showed 17.22%, 19.32% and 20.00% lower vitamin C levels respectively for CAT-I, CAT-II and CAT-III subjects than CG after the end of the intervention (12 weeks).

DISCUSSION

This investigation showed that the MDA level reduced; and SOD, CAT, GPx, vit E and vit C levels increased among the subjects of MHDG at end of the study (12 weeks) when compared to base line (0 week). It can be suggested that, yogic practice might be the cause of improvement in OS and antioxidant levels among the participants of MHDG. Further, significantly higher level of MDA; and lower level of SOD, CAT, GPx, vit E and vit C was noted among the subjects of MHDG when than CG at the beginning (0 week) and end of the study (12 weeks). It can be stated that as the subjects of CG were free from mental illness, therefore, the differences was existed. In addition, age wise difference in MDA, SOD, CAT, GPx, vit E and vit C was level was observed among the subjects of MHDG and CG. It can be stated that as the age increased the level of MDA increased and the levels of SOD, CAT, GPx, vit E and vit C decreased. This showed that these changes are associated. It can be stated that as the age enhanced the levels of stress increased which was reflected in the OS-antioxidant levels.

The ROS and RNS may cause OS which is the underpinning reason of mental illness. The ROS are produced during cellular metabolism which may cause the oxidative damage to lipids, nucleic acids, and proteins in the cell. Oxidative stress has recently been intertwined in depression and anxiety- related conditions. Likewise, the manifestation of anxiety in numerous psychiatric conditions, analogous as generalized anxiety complaint, depressive complaint, fear complaint, phobia, obsessive-compulsive complaint, and posttraumatic stress complaint, highlights the significance of studying the underpinning biology of these conditions to gain a better understanding of the complaint and to identify common biomarkers for these conditions [34]. Antioxidant remedial strategies can prevent psychiatric conditions [34]. A study suggested that the OS level is the central factor in major depressive disorder (MDD), Alzheimer’s disease (AD) and many other mental problems which affect the cognitive and physical conditions [35]. In individualities with a genomic vulnerability to depression these cascade may affect in habitual depression- anxiety- stress spreads, performing in MDD and other given depressive runs. In a recent study a group of

experimenters also reported that OS is a part in internal diseases. Still, it isn't clear whether the OS is the cause or consequence of the complaint [36]. They have reported that antioxidant supplementation may improve the level of SOD, CAT, GPx in patients having depression [36].

The cellular and molecular reason behind psychiatric conditions is modest, but inheritable vulnerability and environmental factors are the principal cause of the conditions. Autism, schizophrenia, bipolar complaint and major depressive complaint show inheritable gene trouble imbrication and share symptoms and metabolic comorbidities. The identification of similar common features may give perceptivity into the development of these conditions. It was also observed that rise in inflammatory condition and OS were noted with advancement of MDD, although there's significant diversity across studies [37]. Multiple attestations suggested that brain energy metabolism, mitochondrial functions and redox balance are crippled to colorful degrees in psychiatric conditions [38]. Since mitochondrial metabolism and redox signalling can integrate inheritable and environmental factors affecting the brain, it's possible that they're intertwined in the etiology and progression of psychiatric conditions [38]. The MDD depends on many factors with high frequency and prognostic in the nearest 15 times. The mechanisms of depression are still known. Imbalances of neurotransmitters are related to depression. Neuropsychiatric conditions such as MDD may be linked to OS and ROS which damage the gene and chromosome which may shorten the telomerase [39]. The OS parameters were found to increase in depression, and it has been considered as indicator of depression status, and supplementary effects of antioxidants may be protective [39]. The hospital based study compared the MDA labels, between depressed cases and healthy controls, and after antidepressant drug application the level of MDA dropped and was found similar to control [40]. They stated that OS parameters may be used as tool for evaluation of depressive situation when antidepressant drug was applied [40]. It was reported that subject with mental illness having poorer sleep quality, high BMI inflammation, OS compared to control [41].

Yoga has a part in maintaining health and physical fitness. The subjects performed yoga exercise which involved yoga asana, prayanama and meditation. Yogic practice might be the reason of improvement of respiratory muscles activities which influences the metabolic activities of the body. The combined effects of asana and respiratory involvement have shown significant positive impact on reduction of cardiac functions among the subjects. Anulom-vilom (Nadi Shodhan) alternate nostril breathing technique a part of pranayama increased the resistance of respiratory muscles which might increase the strength of respiratory muscles. During yoga practice variation in breathing techniques might cause the

respiratory apparatus to empty and fill quickly, completely and efficiently which might be the cause of increase in lung volumes. Pranayama might influence the higher centre of the brain that regulates respiration which might be the possible reason for improvement of respiratory functions. Yogic practice maintains peace of mind, which may reduce stresses. Meditation a part of yoga practice which can improve cognitive functions. Meditation also decreases the stress, psychological strain, and is believed to remove the bronchoconstrictor action. Yoga practice improved the SOD, CAT, and GPx, vit E and vit C levels; and reduced the MDA level among the volunteers. The probable reason for this might be change in metabolic activities and oxygen utilization by the cells. This is supported by other studies. Yoga practice improves the antioxidant capacity and prevents OS. Yoga practice amplified the SOD activity and prevents damage due to ROS and RNS. Yogic practice causes relaxation by practicing pranayama and meditation, which are associated with increased the depth of respiration and decreased in respiratory rate [42]. It can be suggested that yogic practice minimize in respiratory rate following which might lower serum MDA level. Thus regular yoga practice may lower OS and improve the antioxidant levels which may reduce the risk of stress and thus minimize the level of depression.

CONCLUSION

Mental health disorders or illness are leading public health problems worldwide. Mental illness affects mood, behaviour, feeling, cognitive aspect and personality. The mental health disorders can also affect normal functions of different body systems including bodies defence mechanisms. It has been seen that OS is related to neurological and neuropsychiatric disorders, neurodegenerative disease to epilepsy and sleep disorders. Assessment of OS and antioxidant levels may be used an indicator of mental illness. In the present study, it was observed that the higher level of MDA; and lower level of SOD, CAT, GPx, Vit E and Vit C were noted among the subjects having psychological disorders when compared to normal individuals. It was observed yogic practice reduced the level of MDA and improved the levels of SOD, CAT, GPx, Vit E and Vit C among the subjects of psychological disturbances at the end of the investigation (12 weeks). Age wise difference in the above variables was also observed among the groups. Yogic practice is a type of exercise that involves different asana, respiratory activates and meditation. Yoga practice also is useful for management of mental and emotional problems, such as stress, anxiety, or depression. The short term yoga practice improved OS and antioxidant levels and thus it is helpful to reduce the effects of stress, anxiety and depression among the patients.

It is recommended that yoga may be used as therapy for patients with mental illness.

ACKNOWLEDGEMENT

The authors recognize the participation of the subjects, yoga instructors, lab technicians and students in this investigation.

Funding: There was no financial support for this work.

Conflicts of interest: The study has no friction of attentiveness.

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