International Journal of Yoga, Physiotherapy and Physical Education
www.sportsjournal.in
ISSN: 2456-5067
Received: 20-07-2022, Accepted: 07-08-2022, Published: 22-08-2022
Volume 7, Issue 4, 2022, Page No. 71-82

Effect of mindfulness and/or yoga practices on selected psychological parameters of sportsperson: A meta-analysis

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Abstract
Mindfulness and yoga are a combination of psycho-physical-physiological practices that helps in relaxing the body and mind, improves the tolerance threshold in injured athletes, reduces resting heart rate, blood pressure, and improves cognitive function, well-being, endurance, sleep and injury recovery time in sportsperson. An electronic database search was conducted using the keywords 'mindfulness', 'yoga', 'psychology', and 'athletes' from January 2000 to January 2021. A total of 27,197 records were identified from which 32 studies were finalised for critical analysis after applying inclusion/ exclusion criteria. Over half (65.63%) of the researches included were longitudinal studies or randomised controlled trials and there is an increase (research frequency) from 2011 in the number of studies involving mindfulness and yoga as an intervention for selected psychological parameters in sportspersons. It was noted that on an average more studies were conducted on female subjects than males and the average mean age for the samples was 23.82 ± 2.57 years. The average acute (in minutes) and chronic (in days) treatment protocol duration for all the studies were 18 minutes and 50.35 days respectively. Most of the researches involved mindfulness training intervention (21.88%) followed by mindfulness sport performance enhancement (18.75%), and yoga intervention (12.50%), however, mindfulness meditation therapy, relaxation techniques, cognitive behavioural training, mind body exercise intervention, mindfulness-based intervention and mindfulness meditation training for sports 2.0 were the least employed methods that represented 3.13% each of the total studies. It was concluded that various mindfulness and yoga interventions are useful in order to enhance mindfulness, improve mental health, attention, concentration, sports performance, and reduce competition stress and anxiety.

Keywords: meta-analysis**,** mindfulness, psychology, sportsperson, yoga

Introduction

Mindfulness and yoga are the holistic practices that help an individual to be fully aware of both internal and external stimuli, his/her actions and not being overly reactive or overwhelmed by the situation around (Josefsson *et al*., 2017) [21]. Mindfulness is a type of meditation in which an individual intently focuses on being aware and engaged of the perception, feeling and thinking at the moment, without trying to control, interpret, distract, change, avoid or judge any internal experiences (Josefsson *et al*., 2017; Meggs & Chen, 2021; Bernier *et al*., 2009) [21, 28, 3].

Whereas yoga includes a set of psycho-physical-physiological practices such as postures *(asanas),* controlled breathing techniques (*pranayama),* contemplation *(dharana), and* meditation *(dhyana)* (Briegel-Jones *et al*., 2013; Knothe & Flores Marti, 2018) [4, 24]. Mindfulness could be practiced almost everywhere and some of the techniques includes breathing methods, guided imagery, meditation practices that can be combined with other practices for instance, yoga or sports to relax the body and mind that can also help in reducing stress (Briegel-Jones *et al*., 2013) [4].

It is of great benefit in games and sports to enhance the task performance, flow, gain insight and awareness of personal thoughts, feelings and other internal stimuli by increasing observation and attention of the sportsperson (Cathcart *et al*., 2014; Goodman *et al*., 2014) [8, 15]. Recent research has demonstrated that mindfulness increases the tolerance threshold in injured athletes (Ivarsson *et al*., 2015) [18]. It also helps to strengthen the immune system, reduce blood pressure, improve cognitive function, well-being, endurance, sleep and injury recovery time in sportsperson (Zhang *et al*., 2019; Sharma, 2015; Ross & Thomas, 2010) [44, 40, 38].

Yoga practice also has positive effect on the health and performance of sportsperson (Cadieux *et al*., 2021). It is an established fact that apart from the physiological benefits, a high degree of concentration and focus is achieved through regular yoga practice that further results in calm and controlled mind which is an important factor for efficient performance in games and sports (Sharma, 2015; Atkinson, 2009) [40, 2].

Many researches have depicted that mindfulness and yoga practices can play a key role in cultivating mind control and concentration that can help a sportsperson to perform at their peak level (Minkler *et al*., 2020; Bühlmayer 2017) [30]. Therefore, this review will elicit and analyze the studies conducted on selected psychological parameters to observe the effectiveness of mindfulness and/or yoga in sportsperson.

Materials and Methods

The research studies included were collected from online databases for instance Google Scholar, Science Direct, PubMed and Wiley Online Library that were published from January 2000 till January 2021. The keywords used for the collection of the research articles were "mindfulness", "yoga", "psychology" and "athletes". A total of 27,197 studies were identified. After applying the inclusion and exclusion criteria, a total of 32 studies were selected as the relevant literature for critical analysis.

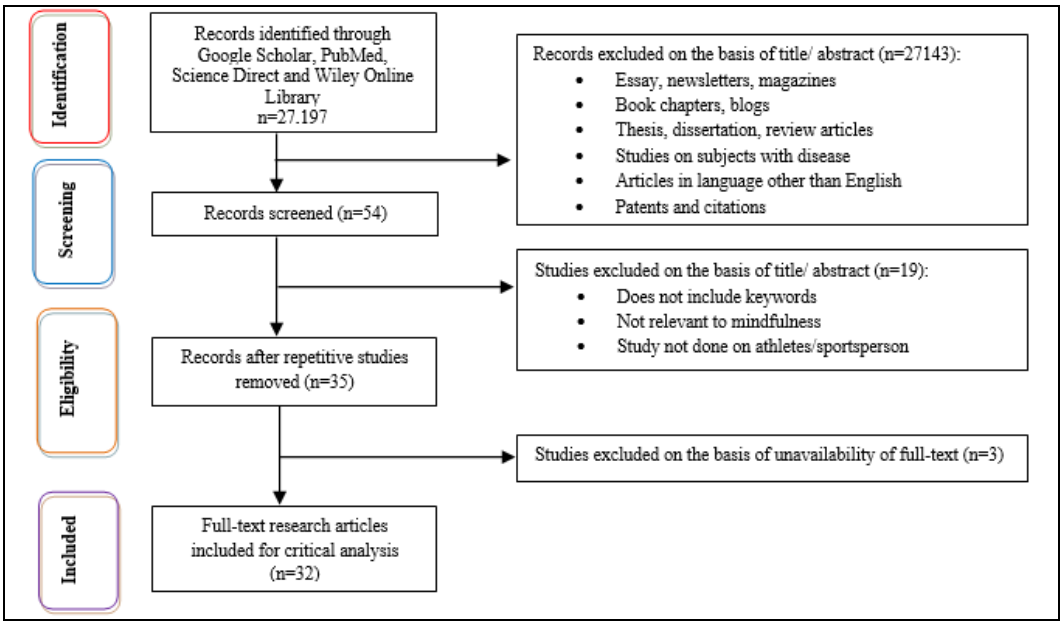


Fig 1: Flow Chart Depicting the Selection of Studies on Effect of Mindfulness and/or Yoga Practices on Selected Psychological Parameters of Sportsperson

Results

The results of the selected studies with respect to their study design, total and gender-based sample size, number of groups and subjects in each group, intervention and duration of protocol has been tabulated in the table 1.

Table 1: Summary of Studies Depicting the Effect of Mindfulness and/or Yoga Practices on Selected Psychological Parameters in Sportsperson

Study	Design	Size: Gender	Group	Intervention	Protocol	Result
De Patrillo *et.al*., (2009)	LS	25: M=10 F=15	MT=13; CG=12	MiT	4 weeks	-↑ state Mi, trait awareness & ↓ sport-related worries, personal standards perfectionism & parental criticism.
Kaufman *et. al*., (2009)	LS	32: M=23 F=9	NA	MSPE	4 weeks	-Mi had +ve rels. with overall flow, challenge-skill balance, action & awareness, clear goals, loss of self-consciousness & autotelic experience of flow dimensions
John *et. al*., (2011)	LS	110 (M)	EG=55; CG=55	Mi MT	4 weeks	-EG showed ↓ in PCS level & ↑ in shooting performance
McCarthy, J. (2011)	CSS	52: M=16 F=36	NA	NA	NA	+ve correlation b/w gender & level of task orientation with athletes; Athletes with more Mi score more on goal achievement orientation
Thompson *et. al*., (2011)	CSS	25: M=14 F=11	NA	NA	NA	-Athlete showed ↑ in the ability to act with awareness

						& ↓ in task-related worries & task-irrelevant thoughts
Aherne *et. al*., (2011)	RCT	13	EG=6; CG=7	MiT	6 weeks	-MiT ↑ global flow scores & also flow dimensions of "Clear Goals" & "Sense of Control"
Briegel-Jones *et. al*., (2013)	LS	21: M=10 F=11	EG=10 (M=3, F=7); CG=11 (M=7, F=4)	Sivananda Yoga	10 weeks	- Changes in Mi & dispositional flow were not identified in IG. -Individuals reported perceived ↑ in Mi & flow
Bryan S. and Pinto Zipp G. (2014)	RCT	45: M=14 F=31	EG=29; CG=16	Yoga; Indoor cycling	8 weeks	-↑ in Mi in the IG -Significant impr. were found in the facets of observe & non-judge
Gross *et. al*., (2016)	RCT	F=22	MAC=11; PST=11	MAC and PST	7 weeks	-MAC group effectively ↓ substance use, hostility & emotion dysregulation over time compared to PST group -MAC group had ↓generalized anxiety, eating concerns & psychological distress -MAC group ↑ psychological flexibility from post-intervention to one-month follow-up
Worthen D. and K. Luiselli J. (2016)	LS	F=32	Volleyball=13; Soccer=19	MiT	10 weeks	-Volleyball participants had highest avg. ratings for council practice, applying Mi to other sports, effects of Mi on becoming more aware of emotions -Soccer participants had highest avg. ratings for Mi contributing to effective team play, Mi helping with awareness of body sensations
Mardon *et. al*., (2016)	QES	6: M=2 F=4	NA	MiT	8 weeks	-Three of six participants had large impr. in Mi & attention efficiency -Four participants impr. performance times compared with season-best -Five participants impr. self-rated performance
Scott-Hamilton J. and S. Schutte N. (2016)	LS	12: M=10 F=2	NA	MI	8 weeks	-Athletes high in adherence showed greater ↑ in Mi & aspects of flow, &↓ in pessimism & anxiety than low adherence athletes
E. Perry *et. al*., (2017)	RCT	65	IG=32; CG=33	MI	30 min.	-IG exhibited more successful outcomes on objective putting performance, flow state experience & state anxiety
D. Rooks *et. al*., (2017)	LS	100	MT=56 RT=44	MiT and RT	4 weeks	-Greater engagement in both MiT & RT predicted -ve change in anxiety & +ve change in affect over the high-demand interval
Kusuma and Bin (2017)	RCT	20: M=12 F=8	EG=10 CG=10	EG=Yoga; CG= CBP	6 weeks	-Yoga group experienced ↑ in HR, self-confidence,

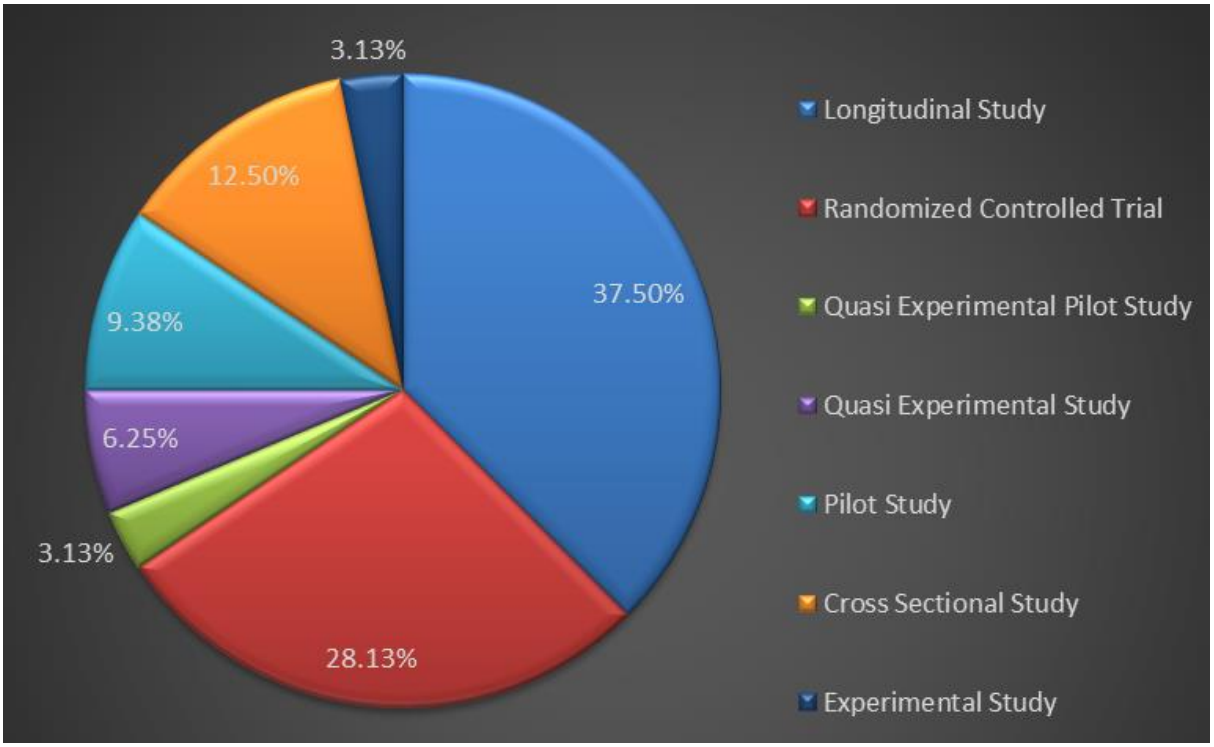
						badminton performance -↓systolic, diastolic bp, cognitive anxiety, somatic anxiety -CG experienced ↑ in diastolic bp, heart rate, somatic anxiety in systolic bp, cognitive anxiety, self-confidence, badminton performance
G. Mistretta *et. al*., (2017)	LS	45: M=8 F=37	MSPE; CG	MSPE training	6 weeks	-Athletes who hoped for impr. in stress, anxiety & worry showed larger ↓ on the concentration disruption subscale of SAS -Impr. in DFS subscale of Action-Awareness Merging -Athletes who did not report responses coded as hoping for other sport-related psychological impr. had greater impr. in depression & concentration disruption -Athletes who expected benefits to their sport performance before beginning MSPE showed greater ↓ in Worry subscale of SAS
Chen *et. al*., (2018)	PS	M=21	NA	MSPE training	4 weeks	-Impr. in flow state, cognitive anxiety in competitive anxiety, global eating disorder, marked shape concern & weight concern -Scores of sleep disturbance showed impr. at follow-up -Association b/w flow state & mindfulness ability
Glass *et. al*., (2018)	RCT	52	IG; CG	MSPE training	6 weeks	-CG had ↑ in depressive symptoms -Once controls also received MSPE, treatment completers demonstrated significant in flow, trait mindfulness, satisfaction with life & self-rated sport performance, along with ↓ in worry, with medium to large effect sizes
Chunxiao Li *et. al*., (2018)	RCT	63: M=42 F=21	EG=32; CG=31	BMiI	6 min.	-EG reported higher state Mi level; It ↓ pre-sleep arousal & impr. level of rest & overall sleep quality
Zhang *et. al*., (2019)	RCT	F=60	IG=29; CG=31	MBEI: Aerobic;Yoga	8 weeks	-There was impr. in implicit emotion regulation, Mi & aerobic fitness levels
Doron J. *et. al*., (2019)	ES	29	MBI=18:M=10 F=8; Placebo=11: M=5 F=6	MBI Or Placebo	8 weeks	-In performance worries MBI group participants scored lower & scored higher in task-irrelevant
Josefsson *et. al*., (2019)	RCT	68: M=36 F=33	MAC: M=17 F=19; PST Control: M=18 F=14	MAC; PST Control	7 weeks	-Groups had high levels of dispositional Mi, self-reported performance & adherence

						-Moderate to low values of emotional regulation difficulties -MAC intervention had indirect effect on self-rated athletic training performance through changes in dispositional Mi & emotion regulation
Mehrsafar *et. al*., (2019)	PS	25	MBI=13 CG=12	MBI	8 weeks	-MBI group demonstrated ↑ in self-confidence & Mi; ↓ competitive anxiety from baseline to post intervention
Hoja S. and Jansen P. (2019)	QEPS	16	MBI=16 CG=8	MBI	7 weeks	-IG had better performance between post-test & pre-test in concentration disturbances index
Cote T. *et. al*., (2019)	LS	9	NA	MMTS 2.0	13 weeks	-All the participants identified impr. focus as a direct result of their participation in the MMTS 2.0 program
Cherup P. N. and Vidic Z. (2019)	LS	F=17	NA	MiT	18 weeks	-Participants of MFT demonstrated statistically significant diff. in dispositional flow dimensions of loss of self-consciousness & autotelic experience
Minkler O. T. *et. al*., (2020)	PS	F=30	NA	MSPE	6 weeks	-Impr. in sport anxiety, Mi, emotion regulation in MPSE group; Impr. in questionnaire measures of dispositional flow, sport anxiety, mindfulness, difficulties in emotion regulation & sport performance satisfaction, with medium to large effect sizes
Nien J. *et. al*., (2020)	QES	46	MiT=23: M=16 F=7; CG=23: M=18 F=5	MiT	5 weeks	-Post intervention mindfulness level, exhaustion time & Stroop task accuracy scores, regardless of task condition were higher in MiT group
Rao R. M. *et. al*., (2020)	LS	M=82	Yoga=40; CG=42	Yoga Module	6 weeks	-Significant interaction effect at T2 among all the facets except for the facets indicate the impact of yoga on the facets of observe, describe, act with awareness, non-judging & non-reactivity
Ramírez H. J. *et. al*., (2020)	LS	42	EG=20 CG=22	MSPE	6 weeks	-RESTQ-76 Sport ↑ the stress–recovery balance & global recovery; ↓ global stress
Popa D. *et. al*., (2020)	CSS	288	G1=83 G2=109 G3=96	NA	NA	- Variables as state Mi of body, self-monitoring, & self-efficacy, explained 87% of the variance in sports performance in a hierarchical multiple regression
Foster J. B.	CSS	222: M=55	NA	NA	NA	-Both PS & Mi had +ve &

and Chow M. G. (2020)		F=167				moderate effects on sport well-being; Mi showed to have a +ve moderate effect on global well-being

Full forms: NA=Not Applicable; M=Male; F=Female; EG=Experimental Group; CG=Control Group; IG=Intervention Group; ES=Experimental Study; QES= Quasi Experimental Study; PS=Pilot Study; CSS= Cross- Sectional Study; LS=Longitudinal Study; RCT=Randomized Controlled Trial; Mi=Mindfulness; QEPS=Quasi Experimental Pilot Study; MEBI= Mind-body Exercise Intervention; CBP= Cognitive behavioral practice; MT= Meditation Therapy; MAC=Mindfulness; BMiI=Brief mindfulness Induction Acceptance Commitment; PST=Psychological Skills Training; MSPE=Mindful Sport Performance Enhancement; PCS=Pre-Competition Stress; PS=Psychological Skill; MiT=Mindfulness Training; RT=Relaxation Training; MABI=Mindfulness- and acceptance-based Interventions; MBI=Mindfulness based Intervention; MI=Mindfulness Intervention; MMTS2.0=Mindfulness Meditation Training for Sport 2.0; G1=Group 1; G2=Group 2;G3=Group 3; NR=Not Reported; Min.=Minute; ↑=Increase; ↓=Decrease; Rels.=Relationship; +ve=Positive; -ve=Negative; B/w=between; Impr.=Improvement; Avg.=Average; BP=Blood pressure; HR=Heart Rate; SC=Salivary Cortisol; SAS=Sport Anxiety Scale; RESTQ-76=Recovery-Stress Questionnaire Sport; Diff.=Difference

According to table 1 and figure 1, out of 32 studies on the effect of mindfulness and/or yoga practices on selected psychological parameters of sportsperson, a total of 12 studies (37.50%) adopted longitudinal study design, nine studies (28.13%) adopted randomized controlled trial for the study, cross sectional study design was adopted by four studies (12.50%), two studies (6.25%) adopted quasi experimental study design, three studies (9.38%) conducted pilot study. The experimental study design and quasi experimental pilot study design was used by one study (3.13%) each.



Note: Rounded to two digits after decimal

Fig 2: Statistics of Study Design Adopted in the Studies

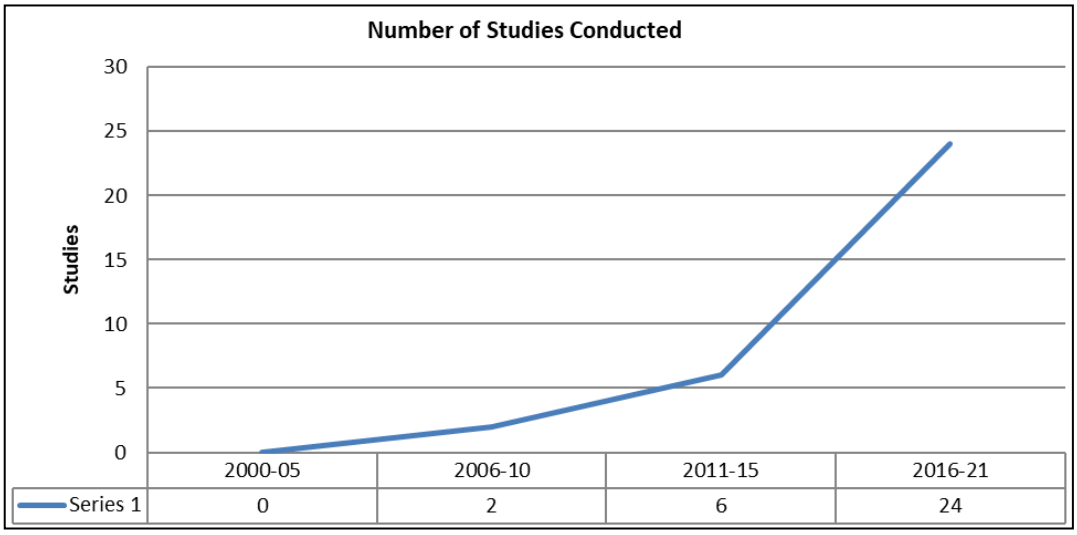


Fig 3: Graph Representing Number of Researches Conducted on Effect of Mindfulness and/or Yoga Practices on Selected Psychological Parameters of Sportsperson from 2000 to 2021

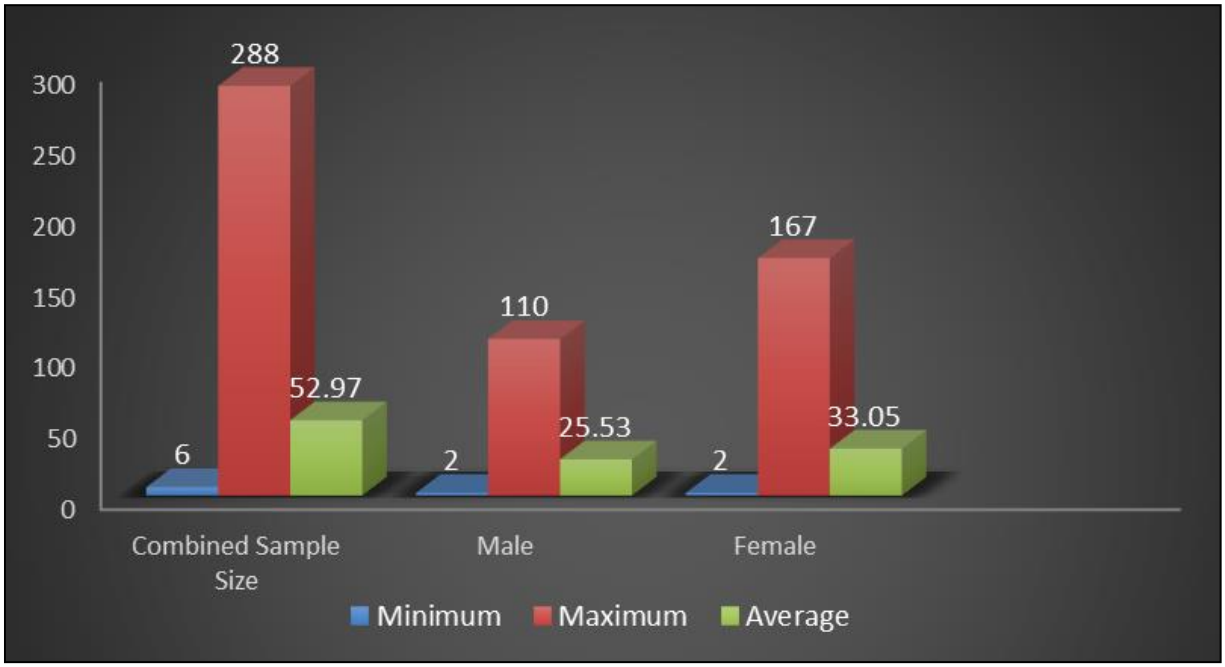
As evident from figure 2, the studies on mindfulness and yoga's effect on psychological parameters in regard to sportspersons have increased considerably over the past two decades. There is an evident sharp increase in the researches especially in the last decade.

Table 2: Statistics of Sample Size and Gender

Sample	Total (N)	Minimum (N)	Maximum (N)	Average (N)
Male + Female	1695	6	288	52.97
Male	383	2	110	25.53
Female	628	2	167	33.05

Note: 11 studies have not reported the gender of the subjects
Rounded to two digits after decimal

It is reflected in table 2 and figure 3 that the total number of subjects (N) in 32 studies was 1695, where minimum sample size was six, maximum sample size was 288 and the average sample size was 52.97. Total number of male subjects in the studies was 383 and total female subjects were 628. Minimum sample size for male and female subjects was two each. Whereas, the maximum sample size for male and female subjects were 110 and 167 respectively. The average male subjects were 25.53, whereas average female sample size was 33.05.



Note: 11 studies have not reported the gender of the subjects
Rounded to two digits after decimal

Fig 4: Statistics of Sample Size and Gender

Table 3: Statistics of Age of Sample in the Study

S.No.	Study	Mean Age (in years)	±	S.D. (in years)
1.	De Partrillo *et.al*., (2009)	34.73	±	-
2.	Kaufman *et.al*., (2009)	52.19	±	-
3.	John *et.al*., (2011)	29.5	±	4.3
4.	McCarthy, J. (2011)	19.76	±	1.3
5.	Thompson *et. al*., (2011)	48.28	±	-
6.	Aherne *et. al*., (2011)	21	±	1.68
7.	Briegel-Jones *et. al*., (2013)	13.24	±	1.51
8.	Worthen D. and K. Luiselli J. (2016)	17.35	±	-
9.	Mardon *et. al*., (2016)	20	±	1.40
10.	Scott-Hamilton J. and S. Schutte N. (2016)	33.57	±	12.50
11.	E. Perry *et. al*., (2017)	18.73	±	0.84
12.	D. Rooks *et. al*., (2017)	19.81	±	1.51
13.	Chen *et. al*., (2018)	26.38	±	2.6
14.	Glass *et. al*., (2018)	19.32	±	1.25
15.	Chunxiao Li *et. al*., (2018)	21.16	±	1.79
16.	Doron J. *et. al*., (2019)	16.43	±	-
17.	Josefsson *et. al*., (2019)	20.95	±	4.2
18.	Mehrsafar *et. al*., (2019)	25.4	±	2.4
19.	Hoja S. and Jansen P. (2019)	26.50	±	6.57
20.	Cote T. *et. al*., (2019)	21.3	±	1.0
21.	Cherup P. N. and Vidic Z. (2019)	19.59	±	1.09
22.	Minkler O. T. *et. al*., (2020)	19.63	±	1.0
23.	Nien J. *et. al*., (2020)	21.5	±	-
24	Rao R. M. *et. al*., (2020)	27	±	-
25.	Ramirez H. J. *et. al*., (2020)	17.15	±	1.3
26.	Popa D. *et.al*., (2020)	13	±	1.79
27.	Foster J. B. and Chow M. G. (2020)	19.74	±	1.37
Mean		23.82	±	2.57

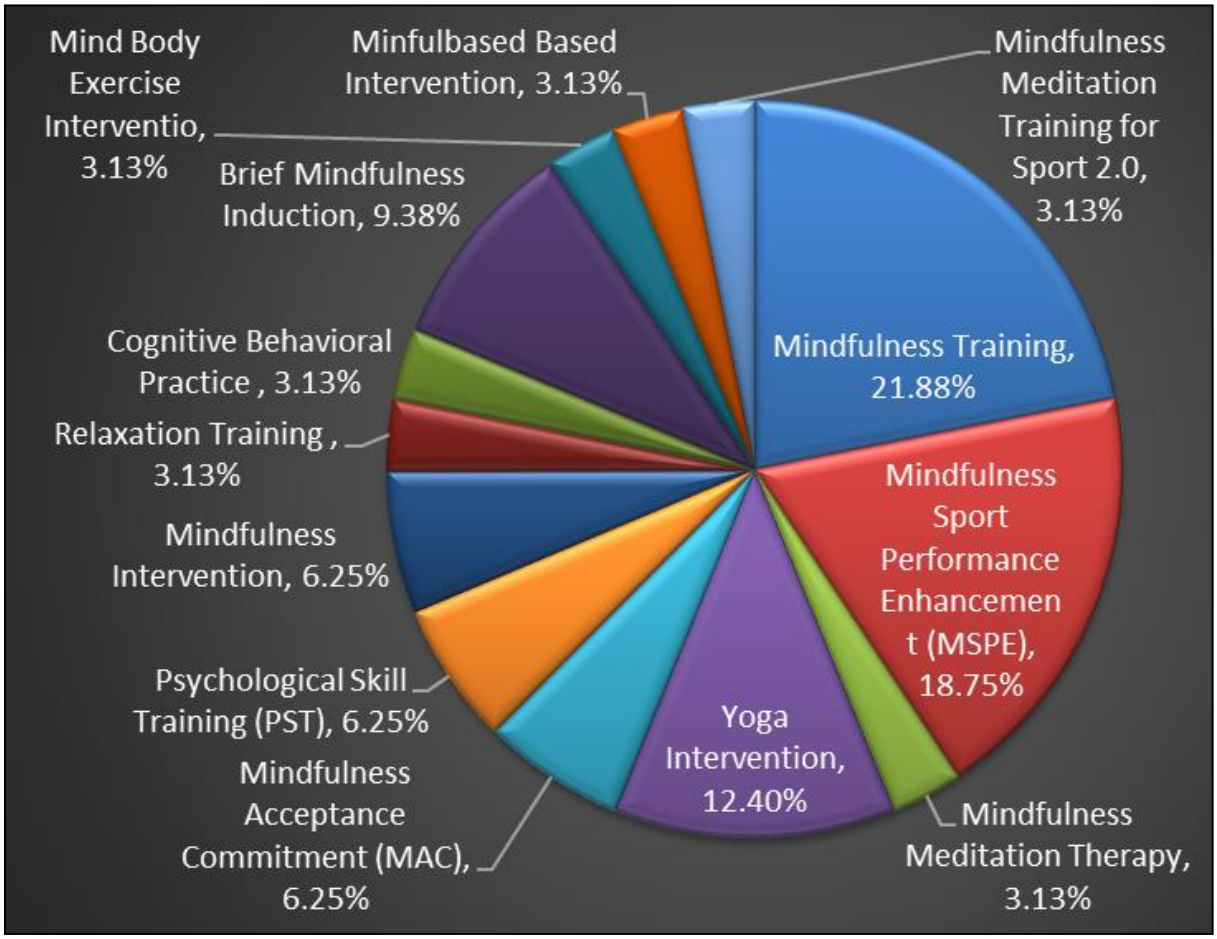
Note: Seven studies have not mentioned the S.D. Five studies have not reported the age of the subjects
Rounded to two digits after decimal

According to the table 3, the minimum mean age was 13 ± 1.79 years, maximum mean age of the subjects was 52.19 years and average of mean age was 23.82±2.57 years.

Table 4: Statistics of Intervention Protocol

Intervention	Frequency (N)	Rank	Percentage (%)
Mindfulness Training	7	1	21.88
Mindfulness Sport Performance Enhancement	6	2	18.75
Mindfulness Meditation Therapy	1	10.5	3.13
Yoga	4	3	12.40
Mindfulness Acceptance Commitment	2	6	6.25
Psychological Skill Training	2	6	6.25
Mindfulness Intervention	2	6	6.25
Relaxation Training	1	10.5	3.13
Cognitive Behavioural Training	1	10.5	3.13
Brief Mindfulness Induction	3	4	9.38
Mind Body Exercise Intervention	1	10.5	3.13
Mindfulness Based Intervention	1	10.5	3.13
Mindfulness Meditation Training for Sport 2.0	1	10.5	3.13

Note: F=No. of studies adopted particular intervention
There were four studies that applied two interventions in order to understand the effect of two different interventions at the same time of the experiment on two different groups.



Note: There were four studies that applied two interventions in order to understand the effect of two different interventions at the same time of the experiment on two different groups

Fig 4: Statistics of Intervention Protocol

The table 4 and figure 4 depicts that mindfulness training intervention was used in most of studies (21.88%) followed by mindfulness sport performance enhancement (18.75%), yoga intervention (12.50%), brief mindfulness induction (9.38%), and mindfulness acceptance commitment, psychological skill training and mindfulness intervention (6.25% each). However, mindfulness meditation therapy, relaxation techniques, cognitive behavioural training, mind body exercise intervention, mindfulness-based intervention and mindfulness meditation training for sports 2.0 were the least employed methods that represented 3.13% each of the total studies.

Table 5: Statistics of Treatment Protocol Duration

Treatment Protocol (Duration)	Minimum Duration	Maximum Duration	Average Duration
Acute (in minutes)	6	30	18
Chronic (in days)	28	126	50.35

Note: Four studies (McCarthy, J. (2011); Thompson *et. al*., (2011); Popa D. *et. al*., (2020); Foster J. B. and Chow M. G. (2020) were cross sectional studies.

The table 5 distinctly put forth the minimum, maximum and average duration of intervention for acute treatment that was six minutes, 30 minutes, and 18 minutes respectively. In regard to chronic treatment, the minimum, maximum, and average treatment protocol duration was 28 days, 126 days, and 50.35 days respectively.

Discussions

Studies conducted by De Patrillo *et. al*., 2009; Kaufman *et. al*., 2009 [11, 23], suggests that mindfulness sport performance enhancement intervention improves mindfulness among sportsperson. Thompson *et. al*., 2011 [41], suggests that mindfulness sport performance enhancement intervention is associated with long-term changes in trait variables and contributes to optimal athletic performance. G. Mistretta *et. al*., 2017, advocated that mindfulness sport performance intervention is a positive experience and reported same benefits as were expected by the athletes. Glass *et. al*., 2018 [14], suggests that mindfulness sport performance enhancement intervention promotes well-being among athletes. Minkler O. T. *et. al*., 2020 [30], suggests that mindfulness sport performance intervention can be delivered by a trained coach to potentially benefit athlete's well-being and performance satisfaction. John *et. al*., 2011 [19], states that pre-competition stress can be decreased and psychological skill can

be increased by mindfulness meditation therapy if intervened for chronic treatment protocol duration. Aherne *et. al*., 2011; Mardon *et. al*., 2016 and Nien J. *et. al*., 2020 [1, 26, 32], advocates that mindfulness training is an effective intervention to improve mindfulness and could be used for performance enhancement in chronic treatment protocol duration among athletes. Briegel-Jones *et. al*., 2013 [4]; Bryan S. and Pinto Zipp G. 2014 [5] and Rao R. M. *et. al*., 2020 [36], suggests that yoga intervention for chronic treatment protocol can be used to improve mindfulness among sportsperson. Gross *et. al*., 2016; Josefsson *et. al*., 2019 [16, 20], suggests that seven-week mindfulness acceptance commitment can be effective intervention to improve mindfulness and sports performance among athletes. Scott-Hamilton J. and S. Schutte N. 2016; E. Perry *et. al*., 2017 and Cherup P. N. and Vidic Z. 2019 [39, 33, 42], recommend mindfulness intervention (acute and chronic) is useful to improve athletic performance and produce psychological benefits. Kasuma and Bin 2017 [22], states that chronic duration yoga practice can decrease anxiety and increase sports performance. Chen *et. al*., 2018 [9], states that mindfulness sport performance enhancement training strengthens flow state and mental health of players. Mehrsafar *et. al*., 2019; Hoja S. and Jansen P. 2019 [29, 17], suggests that chronic mindfulness-based intervention is an effective tool to decrease stress and concentration problem in sports competition.

From the above study it can be concluded and hypothesized that mindfulness and/or yoga practices are important for performance enhancement of a sportsperson.

Conclusions

1. Different mindfulness interventions for instance, mindfulness training, mindfulness sport performance enhancement and mindfulness acceptance commitment are useful in order to improve and enhance mindfulness, mental health, attention and concentration. It is an effective way to lower competition stress, anxiety and increase sports performance.
2. Psychological skill and mindfulness interventions enhance both sports performance and overall well-being of sportsperson.
3. Yoga intervention could be used to enhance mindfulness among sportsperson.

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