Psychology Research and Behavior Management

Dovepress
open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Mindfulness training enhances flow state and mental health among baseball players in Taiwan

This article was published in the following Dove Medical Press journal:
Psychology Research and Behavior Management

Jian-Hong Chen[1,2,*]
Po-Hsin Tsai[1,2,*]
Yin-Chou Lin[2,3]
Chih-Ken Chen[1,2]
Ching-Yen Chen[1,2]

[1]Department of Psychiatry, Chang Gung Memorial Hospital at Keelung, Keelung, Taiwan, Republic of China; [2]School of Medicine, Chang Gung University, Taoyuan, Taiwan, Republic of China; [3]Department of Rehabilitation, Chang Gung Memorial Hospital at Taoyuan, Taoyuan, Taiwan, Republic of China

*These authors contributed equally to this work

Objective: To examine the effect of mindfulness-based training on performance and mental health among a group of elite athletes.

Methods: This study aimed to evaluate the effect of mindful sport performance enhancement (MSPE) on mental health, flow state, and competitive state anxiety using a 4-week workshop. We recruited an amateur baseball team (N=21) in Taiwan, and collected information by self-reported questionnaires administered before, immediately after, and at a 4-week follow-up. The primary outcome was to evaluate sports performance by flow state and competitive state anxiety, which included self-confidence, somatic anxiety, and cognitive anxiety. The secondary outcome was to explore whether MSPE intervention can improve anxiety, depression, sleep disturbance, and eating disorders.

Result: After the workshop and follow-up 1 month later, we found improvements in flow state (P=0.001; P=0.045), cognitive anxiety in competitive anxiety (P=0.056; P=0.008), global eating disorder (P=0.009; P<0.001), marked shape concern (P=0.005; P<0.001), and weight concern (P=0.007; P<0.001). Scores of sleep disturbance (P=0.047) showed significant improvement at follow-up. We also found significant association between flow state and mindfulness ability (P<0.001).

Conclusion: This is the first mindfulness intervention to enhance athletes' performance in Taiwan, and also the first application of MSPE for team sports. Our study results suggested that mindfulness ability is associated with flow state, and that MSPE is a promising training program for strengthening flow state and mental health.

Keywords: elite athletes, eating disorders, sport performance, competitive anxiety, sport psychology

Introduction

Elite athletes have a comparable high prevalence of mental disorders like depression, anxiety, eating disorders, substance use, and compromised coping strategies.[1] In Australia, when researchers addressed the mental health of elite athletes from national sporting organizations, they found a similar prevalence of mental disorders among athletes and members of the community at large.[2]

The flow state, which has been described by Csikszentmihalyi,[3] is an optimal psychological state where people are fully engaged in activities and experiences many positive outcomes. It includes total concentration, relaxation, confidence, high energy, a present-centered focus, extraordinary awareness, feeling of being in control, and detachment from distractions. The flow state can be observed in different fields like music, surgery, painting, chess, and sports. Successful athletes described the period in which they achieved peak performance as "the zone", which was correlated to the

Correspondence: Ching-Yen Chen
Department of Psychiatry, Chang Gung Memorial Hospital at Keelung, 8F, No 200, Ln 208, Jijin 1st Road, Anle District, Keelung 204, Taiwan, Republic of China
Tel +886 2 2432 9292 ext 2725
Fax +886 2 2431 5931
Email psycychen@yahoo.com.tw

submit your manuscript | www.dovepress.com
Dovepress
http://dx.doi.org/10.2147/PRBM.S188734

flow state described by Jackson and Csikszentmihalyi.[4] They classified the flow state of athletes into nine characteristics: challenge–skill balance, action-awareness, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, a loss of self-consciousness, the transformation of time, and autotelic experience.

Mindfulness shares similarities with flow state, and because it is based on moment-to-moment experiences, it can promote attention regulation, emotional regulation, and body awareness. The main concept of mindfulness is nonjudgmental awareness toward worries, emotions, or ideas instead of trying to control or suppress them. Mindfulness training is a technique for improving concentration, which is an attention-focused strategy that originated in the Buddhist meditative tradition. Kee and Wang[5] found that the higher the mindfulness traits, the higher the score for flow dispositions of challenge–skill balance, clear goals, concentration, sense of control, and loss of self-consciousness. According to the above concepts, we assumed that mindfulness training could improve the flow state and further affect athletic performance.

Along with medical and psychological treatments, mindfulness has been proven to be effective in treating people suffering from many challenges, including chronic pain,[6] anxiety, depression,[7] stress,[8] and eating disturbances.[9] The most widely used mindfulness-based training program is mindfulness-based stress reduction (MBSR). It was originally designed to assist people with pain and a range of conditions that were initially difficult to treat in a hospital setting. MBSR uses a combination of mindfulness meditation, body scan (the skill of focusing attention on one's whole body, part by part, starting from the little toe) for self-awareness, and mindful yoga. The program was developed in the 1970s by Professor Jon Kabat-Zinn at the University of Massachusetts Medical Center.[10] The MBSR program includes an 8-week workshop that includes 3 hours of training a week, homework, and a 1-day silent retreat. It is taught by certified trainers, and includes group meetings, homework, and instruction.

Dr. Kabat-Zinn was perhaps the first researcher to apply mindfulness to sports. His group applied mindfulness training for the 1984 U.S. Olympic men's rowing team, proposing that it might help them perform optimally.[11] The mindful sport performance enhancement (MSPE) was a new mental training skill developed by Kaufman et al[12] that was an extension of MBSR and mindfulness-based cognitive therapy. MSPE involves four sessions, and each session is 2.5–3 hours long per week and emphasizes the skills of mindfulness, such as sitting meditation, body scan, mindful yoga, and walking meditation. Kaufman et al found that MSPE enhanced the athletes' peak performance ("flow state") and improved certain performance-related psychological characteristics of archers and golfers. In addition, they found that MSPE could relieve sports-related anxiety and aspects of perfectionism in long-distance runners.[13]

Results of small control study (N=13) revealed that mindfulness training greatly improved flow state in athletes; this improvement was reported not only between intervention and control group, but also pre- and post-interventions. The dimensions of "clear goals" and "sense of control" were particularly improved.[14] The similarity of mediating factors was further clarified through two separate studies, both of which showed that mindfulness enhances sports performance via regulation of rumination and emotion.[15]

In Taiwan, Chang et al found that mindfulness predicts life satisfaction and enhances well-being through fulfillment of basic psychological needs among athletes.[16] Besides, Peng found a negative relationship between mindfulness ability and precompetitive state anxiety in tennis athletes.[17] To our knowledge, no direct evaluation of the effect of mindfulness intervention has been made of elite athletes in Taiwan. This is also the first study to apply MSPE on baseball team sport and evaluate its effects on mental health.

Materials and methods

Design and recruitment

We hypothesized that mindfulness training would enhance mental health, flow state, and competitive anxiety of athletes. We defined this study as pilot study owing to lack of mindfulness training for professional athletes in Taiwan. Considering the motivation of athletes to participate in this study and the stigma that accepting psychological intervention seems to be not tough enough,[18] we conducted this study as prospective, observational study design without control group.

We recruited a city baseball team in Taiwan (N=23, Table 1); 21 (91.3%) of all participants completed the workshop. Two (8.7%) dropped out due to team transfers. The final group of participants were all male amateur baseball players; 9 were pitchers and 12 were fielders. Participants' age ranged from 22 to 30 years (mean age: 26.38 years; SD: 2.60).

All participants had played baseball for more than 9 years, and they currently practiced more than 4 hours per day, five times per week. Six were injured, which took them out of ordinary training programs. Before the workshop began, one (4.8%) reported that he had prior psychological training to improve mental control. However, none of the participants had ever heard or practiced any form of mindfulness training, such as meditation, body scan, or yoga.

Table 1 Demographic data

Gender	21 males
Age (years), mean ± SD	26.38±2.60
Career time (years)	>9
Injury, n (%)	6 (28.6%)
Previous psychological intervention, n (%)	1 (4.8%)
Postworkshop	
Practice time (hours/week)	0.96±0.71
Satisfaction score (total: 100)	87.14±4.39
Would like to recommend to other athletes, n (%)	20 (95.2%)
Improvement in daily life after workshop by self-report, n (%)	
Anxiety	10 (47.6%)
Depression	2 (9.5%)
Sleep	12 (57.1%)
Pain	1 (4.8%)
Confidence	8 (38.1%)
Competitive anxiety	6 (28.6%)
Performance	6 (28.6%)
Follow-up	
Practice time (hours/week), mean ± SD	1.69±2.33
Willing to keep practice, n (%)	20 (95.2%)
Favorite skills, n (%)	
Mindful eating	2 (9.5%)
Mindful breathing	9 (40.9%)
Body scan	15 (71.4%)
Walking meditation	11 (52.4%)
Mindful yoga	3 (14.3%)
Meditation	6 (28.6%)

Procedure

In accordance with the principles of the Declaration of Helsinki, all participants were informed of their ethical rights and assured of confidentiality, and signed informed consent prior to participation was obtained. This study was approved by local ethics committee (Chang Gung Medical Foundation Institutional Review Board, IRB No. 201700484B0). We used self-reported questionnaires to evaluate mindfulness ability, mental health, and sports performance at three time-points: 1) pre-workshop (T0), 2) postworkshop (T1), and 3) 1-month follow-up after the workshop (T2). Questions about mental health included the presence of anxiety, depression, disturbed sleep patterns, and eating disorders. The purpose of those questionnaires was to compare the change of symptoms of mental health after mindfulness training. We were also curious about the change of flow state and competitive state anxiety which may relate to sports performance.

The athletes filled out questionnaires before the workshop began and all were asked to practice mindfulness skills between sessions, and to record the practice time and their impressions of the experiences. At the end of the final session, the athletes filled out the same questionnaire, along with a satisfaction survey. One month after the last session, we collected the questionnaires, recorded the average practice time per week in the current month, and their favorite practice skills.

In consideration of their schedule and the acceptance of the elite athletes, we adopted the protocol of MSPE developed by Kaufman et al[12] as intervention method, and it consisted of only four sessions (Table 2). The first session was an introduction to the workshop, which explains the basic concept of mindfulness and how it can enhance athletes' performance. The session starts with mindful eating by tasting raisin, and participants then practiced mindful breathing and body scan. The second session repeated the previous mindfulness exercise and added mindful yoga practice. At this point, the instructor and athletes began to discuss how to apply mindfulness training into sports. Extended sitting and walking meditations were added in the third session. The final session reviewed all strategies with a group discussion. All reflections the athletes had while practicing mindfulness in daily life or on the field were discussed at the beginning of next session.

Measures

Chinese version of the Patient Health Questionnaire (PHQ-9)

The PHQ-9 is a screening tool for depression based on diagnostic criteria. This nine-item questionnaire uses a four-point scale from 0 (never) to 3 (nearly every day). Liu et al testified that the PHQ-9 has good internal consistency (α=0.80) and validity.[19] These authors also found that the two subscales, PHQ-2 and PHQ-1, are effective for predicting major depressive disorders among patients in Taiwan.

Beck Anxiety Inventory (BAI)

The BAI is a 21-question, multiple-choice self-report inventory, which assessed the severity of each individual's anxiety. The Chinese version of the BAI includes 21 statements rated on a scale from 0 to 3. In this version, anxiety is scored in the following way: 0–7 = minimal anxiety; 8–15 = mild anxiety; 16–25 = moderate anxiety; and 26–63 = severe anxiety.[20]

Chinese version of Eating Disorder Examination Questionnaire (EDE-Q)

EDE-Q evaluates the behavioral features of eating disorders by frequency and severity. It consists of 28 items ranging from "never" to "everyday" and "not at all" to "markedly"; the items are rated from 0 to 6. The internal consistency and test–retest reliability have been tested in a Mandarin version.[21] The EDE-Q can preliminarily screen for the presence of restrictive eating, eating concern, shape concern, and weight concern.

Table 2 Protocol for mindfulness sport performance enhancement

Session	Aim	Main content
Session 1 (2.5 hours)	Static	Orientation and rationale (30 minutes) Group introduction Raisin exercise (30 minutes) Mindful breathing (15 minutes) Body scan (45 minutes) Diaphragmatic breathing (3 minutes) Homework
Session 2 (2.5 hours)	Sitting	Body scan (45 minutes) Discuss homework Discuss how to apply it to sport Sitting meditation (15 minutes) Mindful yoga (45 minutes) Diaphragmatic breathing (3 minutes) Homework
Session 3 (2.5 hours)	Motion	Mindful yoga (45 minutes) Discuss homework Extended sitting meditation (45 minutes) Walking meditation (10 minutes) Diaphragmatic breathing (3 minutes) Homework
Session 4 (3 hours)	Conclusion	Sitting meditation (30 minutes) Discuss homework Body scan (45 minutes) Walking meditation (10 minutes) Diaphragmatic breathing (3 minutes) Review, conclusion, and homework

Chinese Pittsburg sleep quality index (CPSQI)

Pittsburg Sleep Quality Index is a self-reported inventory that has seven dimensions of sleep, such as subjective sleep quality, sleep latency, sleep duration, habitual sleep efficacy, sleep disturbances, use of sleeping medication, and daytime dysfunction. It has been translated into a Chinese version (CPSQI), and is a good tool for evaluating community-based people with primary insomnia, due to its high sensitivity and reliable outcome.[22]

Flow State Scale-2 (FSS-2)

Flow state was evaluated by FSS-2, which consists of nine dimensions of the flow state, including challenge–skill balance, action-awareness, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, loss of self-consciousness, the transformation of time, and autotelic experience (a self-contained activity done not with the expectation of future benefit, but simply because doing the activity is reward in itself). The Chinese version that we used in this study was translated from Nien's Flow State Scale,[23] and extended by Yung-Wei Chen,[24] whose work testified its validity among high school athletes.

Revised Competitive State Anxiety Inventory-2 (CSAI-2R)

CSAI-2R is a sports-specific inventory containing three subscales for measuring self-confidence, somatic anxiety, and cognitive anxiety. The revised version of CSAI-2 was also validated by confirmatory factor analysis, which confirmed that the revised version is more effective for measuring competitive state anxiety in athletes than the CSAI-2.[25] Li tested the revised model of the Chinese version and found good converged validity, discriminate validity, and reliability.[26]

Mindful Attention Awareness Scale (MAAS)

MAAS is the most widely used tool for evaluation of the level of mindfulness. It consists of 15 questions rated from 1 to 6 (1= almost always and 6= almost never). We used the Chinese version of MAAS (CMAAS) that was testified to have good internal consistency and reliability.[27]

In order to compare the matched pairs of pre-workshop, postworkshop, and follow-up, we choose Wilcoxon signed-rank test because the sample size was smaller than 30. A one-tailed Wilcoxon signed-rank test was conducted according to the hypothesis that mindfulness training would improve mental health and performance. In addition, we used the generalized estimation equation to find possible correlations between mindfulness and sports performance. A P-value <0.05 is considered to be statistically significant. Statistical analyses were performed using the SPSS version 23.0 software (IBM Corporation, Armonk, NY, USA).

Results

The scale of anxiety and depression improved both at the time of postworkshop (T1) and follow-up (T2) compared to pre-workshop (Table 3), but this was not statistically significant. Quality of sleep significantly improved until 1 month after MSPE workshop (P_{T1} =0.24; P_{T2} =0.047). We also found promising results among athletes with eating disorders. There was significant improvement on global score of EDE-Q (P_{T1} =0.009), the subscales of shape (P_{T1} =0.005), and weight concern (P_{T1} =0.007). All those effects persisted at least 1 month after workshop with more promising P-value (all P_{T2} <0.001).

Flow state showed definite improvement after the workshop (P_{T1} =0.002) and the effect persisted at the time of follow-up (P_{T2} =0.045) (Table 3). Mindfulness ability did not significantly change over the course. When we used a generalized estimation equation to evaluate the relationship between mindfulness ability and flow state, we found that flow state was positively correlated to mindfulness ability. This was also true at the time-point after the workshop, but the correlation had diminished at follow-up. Mindfulness

Table 3 The change after mindfulness training of mental health and sports: Wilcoxon signed ranks test, one-tailed

Characteristics	MT0	MT1	MT2	ZT1	ZT2
Mental health					
Anxiety (BAI)	7.81	6.81	7.48	−0.55	−0.86
Depression (PHQ-9)	5.24	4.86	4.71	−0.51	−0.84
Sleep (CPSQI)	6.10	5.76	5.19	−0.78	−1.71*
Eating disorder (EDE-Q)					
Global score	1.80	1.48	1.22	−2.26**	−3.36**
Diet concern	1.04	0.95	0.87	−0.31^{+}	−1.56
Restraint type	1.35	1.26	0.90	−0.50	−1.64^{+}
Shape concern	2.37	1.90	1.56	−2.50**	−3.67**
Weight concern	2.11	1.58	1.33	−2.38**	−3.51**
Sports performance					
Mindfulness ability (CMAAS)	46.81	45.48	48.52	−1.12	−0.54
Flow state (FSS-2)	169.38	183.81	179.48	−273**	−1.64*
Competitive state anxiety (CSAI-2R)					
Self-confidence	14.29	14.86	14.19	−1.05	−0.02
Somatic anxiety	11.14	10.38	10.24	−1.52^{+}	−1.34^{+}
Cognitive anxiety	11.24	10.05	9.43	−1.62^{+}	−2.36**

Note: $^{+}P<0.10$; $^{*}P<0.05$; and $^{**}P<0.01$.

Abbreviations: BAI, Beck Anxiety Inventory; CPSQI; Chinese Pittsburg sleep quality index; CMAAS, Chinese version of Mindful Attention Awareness Scale; CSAI-2R, Revised Competitive State Anxiety Inventory-2; EDE-Q, Eating Disorder Examination Questionnaire; FSS-2, Flow State Scale-2; M, mean value; PHQ-9, patient health questionnaire; T0, pre-workshop, T1, postworkshop, T2: 1 month after workshop; Z, Z-score.

ability did not change over time, but it was strongly correlated to self-practice time after workshop (Table 4).

Sport anxiety is another tool to evaluate performance. One of the subscales of sport anxiety, cognitive anxiety, showed significant improvement at follow-up (P_{T1} =0.056; P_{T2} =0.008). The two other subscales, confidence and somatic anxiety, did not reveal significant change at T1 or T2.

We collected the statistics of the Baseball Winter League in Taiwan 1 year before and after the workshop. We found that the earned run average of pitchers participating in the study was improved from 9.33 to 3.50. Walks plus hits per inning pitched improved from 2.44 to 1.34, and balls per nine innings pitched improved from 5.50 to 4.04. The mean of total average of hitters, which is designed to measure hitter's overall contributions, increased from 1.52 to 1.94 (Table 5). Furthermore, after the workshop, the study participants' team's seasonal ranking greatly increased from the ninth place to the second place. Unfortunately, those statistic did not reach significance.

Most of the workshop participants expressed that they would like to promote this psychological training program to other athletes (95.2%). The athletes' top three favorite mindfulness practice skills were body scan (71.4%), walking meditation (52.4%), and mindful breathing (40.9%). The average practice time at home was 0.96±0.71 hours/week during the month of the workshop and increased to 1.69±2.33 hour at follow-up. Most of the participants (95.2%) were willing to keep practicing mindfulness after the study was completed (Table 1).

Discussion

This study is notable as it is the first application of mindfulness training designed for elite athletes in Taiwan and, to our knowledge, constitutes the first application of this training among members of an elite baseball team. It examined whether mindfulness training could improve mental health and sports performance among athletes. Through this prospective observational pilot study, we found that MSPE intervention can improve mental health, especially eating disorders. The effect of improving the quality of sleep emerged after 8 weeks of practice. Besides, MSPE could improve flow state and reduce sport anxiety, which may promote sport performance. These effects persisted at least 1 month after the study ended.

This is the first study to suggest that MSPE may improve mental health, especially the symptoms of eating disorders among athletes. More specifically, MSPE can help ameliorate shape and weight concerns, and can even reduce restrained eating disorders if the individual continuously practices mindfulness. Our study did not show significant changes in depression and anxiety, but we still can see the improvement of mean value of depression and anxiety scale both at time point of postworkshop and follow-up. We assume that MSPE might help symptoms of depression and anxiety, but

Table 4 The trend of flow state and change of mindfulness ability: generalized estimation equation analysis

Variant	Estimate	95% CI of estimate	*P*-values
Flow state			
T2	8.257	−3.907 to 20.420	0.163
T1	15.859	6.431 to 25.287	0.001
T0	0	–	–
Mindfulness ability	1.073	0.510 to 1.635	<0.001
Change of mindfulness ability			
T2	−0.833	−5.139 to 3.473	0.705
T1	−2.987	−6.526 to 0.552	0.098
T0	0	–	–
Practice time	1.222	0.069 to 2.375	0.038

Abbreviations: T0, pre-workshop, T1, postworkshop, T2: 1 month after workshop.

Table 5 Personal and team scores (winter baseball league)

Statistics		2016	2017
Pitchers (mean)	ERA	9.33	3.50
	WHIP	2.34	1.34
	BB/9	5.50	4.04
Hitters (mean)	TA	1.52	1.94
Seasonal ranking		No. 9	No. 2

Abbreviations: BB/9, balls per nine innings pitched, ERA, earned run average, TA, total average of hitters; WHIP, walks plus hits per inning pitched.

we need further study with larger case numbers and control group to testify it.

MSPE was first tested in 2009.[12,13] Although posttest evaluation showed that it did not significantly improve performance for archers, golfers, and runners, long-distance runners' mile time significantly improved during a 1-year follow-up.[28] The authors hypothesized that athletes would show improvement with continued mindfulness practice. Our study also revealed that the flow state of athletes markedly increased after the workshop and persisted to follow-up time. It was also positively correlated to mindfulness ability (Table 4). We had expected that the mindfulness ability would improve after mindfulness training, but it did not significantly change after workshop. We suggested that MSPE may directly enhance performance by multiple facets, and the CMASS is largely focused on the measurement of daily experience of mindfulness attention. Thus, we did not find a significant change in mindfulness ability by CMASS after only 4 weeks of mindfulness training. Despite this, we still can observe the trend of mindfulness improvement over time (Table 3), and mindfulness ability was significantly correlated with practice time at home (Table 4).

Thompson et al[28] found significant decrease in task-worries and task-irrelevant thoughts after mindfulness training. The results of the present study agreed with this hypothesis, which showed that mindfulness training could significantly improve cognitive anxiety among those with sports anxiety. The findings are consistent with the results of mindfulness intervention for cyclist, which suggested improvement of sports anxiety and sport-related pessimism.[29]

Before the study, we approached some sports group and found that it was challenging to recruit athletes because there was no direct mindfulness intervention before the study, and the existing stigma that elite athletes should be mentally strong. The athletes and coaches that we approached were greatly concerned that receiving psychological training meant the players were not tough enough. Furthermore, they were in denial about having any mental problems, and thought they had no need of psychological intervention.

We should interpret the results of this study carefully due to several limitations. First, the sample size was small, 21 baseball players recruited from one team, without control group. Although we reported significant improvement in flow state and cognitive state anxiety, these two are just one of the many aspects that affect athletic performance. Thus, despite the improvement in the mean value of personal and team scores after mindfulness training, we cannot extrapolate the correlation because of inadequate evidence. Therefore, above all, this study was designed as a pilot study. Based on this study results, we should design more rigorous methods, including a randomized control study or even a double-blind study, with a larger group of participants. Also, future studies should be designed to obtain more objective statistics, to determine the relationship between mindfulness training and spot performance, regardless of individual or team scores.

Conclusion

Preliminary findings of this pilot study revealed that mindfulness training was beneficial for athletes. Mindfulness training

can help not only sports performance but also mental health. Flow state and eating disorders were the most improved areas after intervention. Effects of mindfulness training may persist at least 1 month after intervention.

Acknowledgment

The authors would like to thank Chang Gung Memorial Hospital for funding this study (CMRPG2G0481).

Disclosure

The authors report no conflicts of interest in this work.

References

1. Rice SM, Purcell R, De Silva S, Mawren D, McGorry PD, Parker AG. The mental health of elite athletes: a narrative systematic review. *Sports Med*. 2016;46(9):1333–1353.
2. Gulliver A, Griffiths KM, Mackinnon A, Batterham PJ, Stanimirovic R. The mental health of Australian elite athletes. *J Sci Med Sport*. 2015;18(3):255–261.
3. Csikszentmihalyi M, Csikszentmihalyi I. *Beyond Boredom and Anxiety*. Vol 721. San Francisco: Jossey-Bass; 1975.
4. Jackson SA, Csikszentmihalyi M. *Flow in Sports*. Champaign, IL: Human Kinetics; 1999.
5. Kee YH, Wang CKJ. Relationships between mindfulness, flow dispositions and mental skills adoption: a cluster analytic approach. *Psychol Sport Exerc*. 2008;9(4):393–411.
6. Reiner K, Tibi L, Lipsitz JD. Do mindfulness-based interventions reduce pain intensity? A critical review of the literature. *Pain Med*. 2013;14(2):230–242.
7. Hofmann SG, Sawyer AT, Witt AA, Oh D. The effect of mindfulness-based therapy on anxiety and depression: a meta-analytic review. *J Consult Clin Psychol*. 2010;78(2):169–183.
8. Khoury B, Sharma M, Rush SE, Fournier C. Mindfulness-based stress reduction for healthy individuals: a meta-analysis. *J Psychosom Res*. 2015;78(6):519–528.
9. Katterman SN, Kleinman BM, Hood MM, Nackers LM, Corsica JA. Mindfulness meditation as an intervention for binge eating, emotional eating, and weight loss: a systematic review. *Eat Behav*. 2014;15(2):197–204.
10. Kabat-Zinn J. *Wherever You Go, There You Are: Mindfulness Meditation in Everyday Life*. New York: Hachette Books; 2009.
11. Kabat-Zinn J, Beall B, Rippe J. A systematic mental training program based on mindfulness meditation to optimize performance in collegiate and Olympic rowers. Poster presented at: World Congress in Sport Psychology; 1985; Copenhagen, Denmark.
12. Kaufman KA, Glass CR, Arnkoff DB. Evaluation of mindful sport performance enhancement (MSPE): a new approach to promote flow in athletes. *J Clin Sport Psychol*. 2009;3(4):334–356.
13. de Petrillo LA, Kaufman KA, Glass CR, Arnkoff DB. Mindfulness for long-distance runners: an open trial using mindful sport performance enhancement (MSPE). *J Clin Sport Psychol*. 2009;3(4):357–376.
14. Aherne C, Moran AP, Lonsdale C. The effect of mindfulness training on athletes' flow: an initial investigation. *Sport Psychol*. 2011;25(2):177–189.
15. Josefsson T, Ivarsson A, Lindwall M, et al. Mindfulness mechanisms in sports: mediating effects of rumination and emotion regulation on sport-specific coping. *Mindfulness*. 2017;8(5):1354–1363.
16. Chang WH, Chang J-H, Chen LH. Mindfulness enhances change in athletes' well-being: the mediating role of basic psychological needs fulfillment. *Mindfulness*. 2018;9(3):815–823.
17. Peng Y-C. Mindfulness and sport performance: the mediated effect of pre-competitive state anxiety. *NTU J Phys Educ.* 2015;(29):1–13.
18. Bauman NJ. The stigma of mental health in athletes: are mental toughness and mental health seen as contradictory in elite sport? *Br J Sports Med*. 2016;50(3):135–6.
19. Liu SI, Yeh ZT, Huang HC, et al. Validation of Patient Health Questionnaire for depression screening among primary care patients in Taiwan. *Compr Psychiatry*. 2011;52(1):96–101.
20. Hsien-Huei Che M-LL, Chen H-C, Change S-W, Lee Y-J. Validation of the Chinese version of the Beck anxiety inventory. *Formosan J Med*. 2006;4:447–454.
21. Tu CY, Tseng MM, Chang CH, Lin CC. Comparative validity of the internet and paper-and-pencil versions of the night eating questionnaire. *Compr Psychiatry*. 2017;75:53–61.
22. Tsai PS, Wang SY, Wang MY, Su CT, Yang TT, Huang CJ, Fang SC. Psychometric evaluation of the Chinese version of the Pittsburgh Sleep Quality Index (CPSQI) in primary insomnia and control subjects. *Qual Life Res*. 2005;14(8):1943–1952.
23. Nien CL. The preliminary analysis of validity and reliability of Flow State Scale. *Guo Li Ti Yu Xue Yuan Lun Cong*. 2000;11(1):247–260.
24. Yung-Wei Chen Y-CH. The development of flow state scale of high school athletes – from qualitative analysis to quantization. *Phys Educ J*. 2015;48(1):73–91.
25. Cox RH, Martens MP, Russell WD. Measuring anxiety in athletics: the revised competitive state anxiety inventory-2. *J Sport Exerc Psychol*. 2003;25(4):519–533.
26. Li C-h. Evaluating validity and reliability of revised competitive state anxiety inventory-2 (CSAI-2R) by confirmatory factor analyses. *J Phys Educ High Educ.* 2008;10(1):63-74.
27. Jen-Ho Chang Y-CL, Huang C-L. Psychometric properties of the Chinese translation of mindful attention awareness scale (CMAAS). *Psychol Test.* 2011:235–260.
28. Thompson RW, Kaufman KA, de Petrillo LA, Glass CR, Arnkoff DB. One year follow-up of mindful sport performance enhancement (MSPE) with archers, golfers, and runners. *J Clin Sport Psychol*. 2011;5(2):99–116.
29. Scott-Hamilton J, Schutte NS, Brown RF. Effects of a mindfulness intervention on sports-anxiety, pessimism, and flow in competitive cyclists. *Appl Psychol Health Well Being*. 2016;8(1):85–103.