

Mindfulness Enhances Change in Athletes' Well-being: the Mediating Role of Basic Psychological Needs Fulfillment

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Abstract The current study is based on the self-determination theory, which proposes that basic psychological needs fulfillment may account for the relationship between mindfulness and athletes' well-being. Using a two-wave longitudinal design, in the current study, we recruited 104 college athletes (mean age 20.66 years) and facilitated mindfulness, basic psychological needs fulfillment, positive and negative affects, life satisfaction, and subjective vitality measurements. Multiple regressions during the interaction term revealed that Time 1 basic psychological needs fulfillment mediated the relationship between Time 1 mindfulness and Time 2 hedonic well-being (satisfaction with life, positive and negative affects) and Time 2 eudaemonic well-being (subjective vitality) in athletes. In addition, the mediational effect remained evenly controlled in the Time 1 well-being index. Our hypothesis was supported, and the results are discussed in terms of mindfulness and its application in sports.

Keywords Mindfulness · Self-determination theory · Well-being

Introduction

Mindfulness has been described as paying sustained attention to ongoing external and internal experiences with non-judgmental and non-elaborating attitudes (Kabat-Zinn 2003). Recent research in mainstream psychology suggests that mindfulness may be important in interrupting individuals' automatic thoughts, habits, and unhealthy behavioral patterns; thus, it could play a key role in cultivating self-regulation, which has been associated with enhanced well-being (Brown et al. 2009; Brown and Ryan 2003; Howell et al. 2008). Investigating the protective effect of mindfulness in sports is particularly important because athletes must face intensive training and stressful competitions. Those stressful experiences risk damage to athletes' immediate or long-term psychological adjustments (Smith 1986). Thus, understanding athletes' well-being from a mindfulness perspective can help athletes maintain long-term psychological health while participating in competitive sports (Etzel et al. 2006; Lloyd et al. 2016) in which stressful and challenging situations occur routinely.

In sports science, previous studies have found that mindfulness improves athletes' mental states (Aheme et al. 2011; Kee and Wang 2008; Schwanhauser 2009) and actual performance (Bernier et al. 2009; Gardner and Moore 2004; Lutkenhouse 2007; Thompson et al. 2011). Despite the growing interest surrounding mindfulness in sports psychology, little research has, thus far, investigated the mediators that account for the relationship between mindfulness and athletes' well-being. This investigation is critical because it would cultivate our knowledge about how mindfulness may facilitate athletes' well-being. Indeed, several researchers have tried to explore the mediators between mindfulness and well-being. However, most of their studies focused on the cognitive mediators

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(e.g., Schutte and Malouff 2011) but ignored the motivational aspects of the mediators.

Therefore, based on the self-determination theory, we proposed an important potential motivational process (i.e., basic psychological needs fulfillment) that underlines the relationship between mindfulness and well-being. When mindful people are aware of what is occurring in the moment, they are in a better position to make meaningful choices and act, which will further enhance their well-being (Ryan et al. 2008). In light of this issue, only a few cross-sectional studies supported our hypothesis (Chang et al. 2015). However, relying on the results from cross-sectional data may be problematic due to inflated coefficients (Podsakoff et al. 2003). Moreover, the point where reversals in the sign among relationships may occur (Maxwell and Cole 2007) and the mean level of a predictor does not predict changes in outcomes as strongly as the changes in the predictor (Chen et al. 2011).

Mindfulness is a mental state of consciousness in which one gives open and receptive attention and awareness to his/her inner state and the outside world (Kabat-Zinn 2003). The extant literature suggests that mindfulness is beneficial to an individual's well-being because people with high levels of mindfulness tend to accept their situations, which may lead to higher positive cognitive reappraisals of their own lives (Garland et al. 2015). Correlational studies reported that the mindfulness trait is related to subjective well-being (Brown et al. 2009; Howell et al. 2008). For example, greater mindfulness is associated with greater positive affect, greater life satisfaction, and less negative affect (Brown and Ryan 2003). Although the relationship between mindfulness and well-being has been documented, it is likely that basic psychological needs may play a mediating role between mindfulness and well-being if the self-determination theory is taken into account.

Basic psychological needs fulfillment, a subtheory of the self-determination theory (Ryan and Deci 2000), is a framework that proposes people will experience well-being at the degree to which their basic psychological needs are fulfilled—namely autonomy, competence, and relatedness. Autonomy occurs when individuals experience choice and consistency aligned with their values in the activities in which they engage (Patall et al. 2008). When autonomy is satisfied, a person does not feel pressure to respond in a specified way. The need for competence requires people to experience efficacy; then, they have the resources and the ability to achieve competence. Finally, the need for relatedness requires people to experience feelings of care and connection with others.

Ryan et al. (2008) suggested that promoting mindfulness is a way of fulfilling basic psychological needs because mindful people are less controlled and can more easily embrace their values, which leads them to experience less inconsistency between what they have and what

they want (Ryan et al. 2008). Therefore, mindful people can fulfill the need for autonomy through this non-defensive awareness. In addition, people who focus on the present are led to take goal-directed action rather than to engage in self-doubt (Bond et al. 2013). This experience helps more sensitive people achieve their goals and thus helps them to fulfill their need for competence. Finally, in moment-to-moment awareness, people seek to integrate their thoughts and interactions with others and to skillfully choose helpful responses rather than automatically reacting (Carson et al. 2004); thus, they fulfill their need for relatedness. In this regard, mindfulness can fulfill basic psychological needs (Chang et al. 2015).

When people freely choose the activity (autonomy), master the activity (competence), and feel supported by important people (relatedness) during the process, their enjoyment of activities and the autonomous self-regulation of behaviors (Deci and Ryan 2000) is induced, and people are thus happier, optimistic, and more satisfied with their lives when these needs are fulfilled (Ryan and Deci 2000; Ryan et al. 2008). Empirical research has found that basic psychological needs fulfillment predicts well-being across cultures (Heppner et al. 2008; Reis et al. 2000) and diverse life contexts (Adie et al. 2012; Quedsted and Duda 2010, 2011). In the sports domain, Bartholomew et al. (2011) found that athletes' basic psychological needs satisfaction was positively related to their positive affect and negatively related to negative affect and burnout. Based on the review above, mindfulness would exert an effect on athletes' well-being through the fulfillment of basic psychological needs.

The present research used a 5-month, two-wave longitudinal design to investigate the mediating role of basic psychological needs fulfillment on the relationship between mindfulness and athletes' well-being. We adopted both hedonic (subjective well-being) and eudaemonic (subjective vitality) well-being as indicators. Hedonic well-being involves the experience of momentary pleasure, whereas eudaemonic well-being involves acting in a way that is constructive, beneficial, and leads to personal growth. In the present study, subjective vitality—a positive feeling of energy emanating from the self—was targeted as a key indicator of eudaemonic well-being. Overall, the aim of the present research was to examine the mediating role of psychological needs fulfillment in the relationship between mindfulness and changes in athletes' well-being.

Method

Participants

A total of 104 athletes (49 males) from a diverse variety of sports (e.g., basketball, volleyball, tennis, track and field,

soccer, softball, korfbal, and tae kwon do) and with a mean age of 20.66 years ($SD = 1.68$) were recruited from athletic performance and physical education departments in Taiwan. The athletes reported spending 19.76 h ($SD = 5.79$) per week training and, on average, had 7.01 ($SD = 4.15$) years of experience. The majority of participants (56.4%) reported competing at an international level as their highest level of competition, while 19.8% competed at the regional level, and 23.8% competed at a school level.

Procedure

We used a time-lagged design to collect data during two periods to examine the mediating effect. All participants read and signed the consent form that informed them of their ethical rights. Confidentiality and anonymity were also ensured. The participants who volunteered to take part in this study were given a NT\$100 gift voucher as compensation for their time. During the first data collection period, participants were asked to answer questions regarding their mindfulness, basic psychological needs fulfillment, and well-being (life satisfaction, positive and negative affects, subjective vitality). Five months later, data were collected a second time, and this time the only data collected were regarding the participants' well-being measurements.

Measures

Mindfulness

We assessed the participants' dispositional mindfulness via the Mindful Attention Awareness Scale (MAAS), which was originally developed by Brown and Ryan (2003). The Chinese translation of the MAAS was adopted by Chang et al. (2011), and their exploratory factor analysis confirmed the one-factor structure. In addition, an inspection of eigenvalues and the scree plot revealed a marked gap between the first and remaining factors (Factor 1 eigenvalue 5.95; Factor 2 eigenvalue 1.17). The first factor accounted for 34.25% of the total variation across factors. Exploratory factor analysis using the principal-axis method of estimation also showed a single-factor solution and almost identical factor loadings. For the factor derived from maximum-likelihood estimation, the average factor loading was .56. The confirmatory factor analysis demonstrated a satisfactory fit ($\chi^2/df = 2.74$, $GFI = 0.94$, $CFI = 0.91$, $RMSEA = 0.068$), which fit the index criterion recommended by Hu and Bentler (1999); the goodness of fit (GFI), the comparative fit index (CFI), and the root mean square error of approximation (RMSEA) were all acceptable (GFI and CFI values > 0.90 indicated an acceptable fit; $RMSEA < 0.08$ was acceptable).

Good internal consistency (0.88 and .086) and test-retest reliability ($r = 0.75$) were supported. In addressing validity,

the MAAS was positively correlated with positive affect and negatively correlated with negative affect. Previous studies using the Chinese MAAS have demonstrated its acceptable validity and reliability with Chinese participants (Chang et al. 2015). The MAAS contains 15 items (e.g., "I drive to places on 'automatic pilot'"), and the scores for each item ranged from 1 (almost never) to 6 (almost always). The item responses were reverse-coded so that higher scores indicated higher trait mindfulness levels. The Cronbach's α was 0.85 in the present study.

Basic Psychological Needs Fulfillment

We assessed the participants' basic psychological needs fulfillment via the General Need Satisfaction Scale (GNSS; Gagné 2003). Chang et al. (2015) translated the GNSS into Chinese; the same three-factor structure was maintained, and the needs fulfillment was positively correlated with positive affect and negatively correlated with negative affect. The GNSS contained 21 items that measured the extent to which the subjects experienced autonomy (7 items; e.g., "I feel like I can decide for myself how to live my life"), relatedness (8 items; e.g., "I really like the people I interact with"), and competence (6 items; e.g., "Recently, I have been able to learn interesting new skills"); the scores for each item ranged from 1 (not true at all) to 7 (definitely true). Following Gagné's (2003) procedure, we acquired a composite score; higher scores exhibited a greater fulfillment of psychological needs. The Cronbach's α was 0.80 in the present study.

Positive and Negative Affect Schedule

We used the Positive and Negative Affect Schedule (PANAS), which was developed by Watson et al. (1988), to assess the participants' individual-activated negative and positive affects. The PANAS was derived from prior experience-sampling studies on affect (Watson et al. 1988). In the current study, we used the trait version of PANAS, a short measure that reports on positive affect (six adjectives for positive affect include happy, proud, interested, determined, strong, and energetic) and negative affect (six adjectives for negative affect include anxious, frustrated, angry, irritable, afraid, and depressed). Participants indicated their responses on a 7-point Likert scale that ranged from 1 (very slightly or not at all) to 7 (extremely). The internal consistency of positive affect at Time 1 and Time 2 was 0.89 and 0.85, respectively, and the internal consistency of negative affect at Time 1 and Time 2 was 0.90, respectively.

Satisfaction with Life Scale

The original Satisfaction with Life Scale (SWLS) has been used to assess individual subjective well-being in broad

populations (Diener et al. 1985). Wu and Yao (2006) confirmed the single-factor structure of the SWLS-Taiwan version and reported it was measurement-invariant across gender and had good reliability and validity. A sample item reads “In most ways, my life is close to my ideal.” Participants indicated their responses on a 6-point Likert scale that ranged from 1 (strongly disagree) to 6 (strongly agree). The internal consistency of life satisfaction at Time 1 and Time 2 was 0.90 and 0.88, respectively.

Subjective Vitality

In our study, we adopted the 6-item Subjective Vitality Scale (SVS) recommended by Bostic et al. (2000). Based on Ryan and Frederick’s (1997) work, Bostic et al. (2000) developed the SVS to assess individuals’ feelings of positive energy. Evidence for the reliability and validity of the Chinese SVS test scores has been reported by Wong et al. (2014). Previous studies using the Chinese SVS have demonstrated its acceptable validity and reliability with Chinese populations (see Chen et al. 2014; Liu and Chung 2015; Wong et al. 2014). A sample item reads “I feel alive and vital.” Participants indicated their responses on a 6-point Likert scale that ranged from 1 (strongly disagree) to 6 (strongly agree). The internal consistency of subjective vitality at Time 1 and Time 2 was 0.86 and 0.84, respectively.

Data Analyses

We conducted mediation analyses with the bootstrap procedure in SPSS (Hayes 2013). Compared with the traditional approach of Baron and Kenny (1986), recent research suggests that bootstrapping has the advantage of outperforming the Sobel and uses causal step approaches in terms of power and control over the Type I error rate (MacKinnon et al. 2002). Zhao et al. (2010) developed the following typology that outlines the different types of mediation: (a) complementary mediation, whereby the indirect effect and the direct effect both exist and are in the same direction; (b) competitive mediation, whereby the indirect effect and the direct effect both exist and are in opposite directions; (c) indirect-only mediation, whereby the indirect effect exists but there is no direct effect; (d) direct-only non-mediation, whereby a direct effect exists but there are no indirect effects; and (e) no-effect non-mediation, whereby neither direct nor indirect effects exist.

The complementary and competitive mediations described by Zhao et al. (2010) are similar to the term used by Baron and Kenny (1986) to describe partial mediation, while indirect-only mediation is similar to the term “full mediation.” What separates Baron and Kenny’s mediation analysis procedure from Preacher and Hayes’ bootstrap procedure of mediation analysis is that in the latter case, the independent variable (IV) does not need to significantly predict the dependent variable

(DV) in the test of the indirect effects of mediators (MVs) on the IV-DV association (see also Preacher and Hayes 2004; Rucker et al. 2011).

In the present study, we conducted the mediation analysis of the GNSS between the MAAS and indexes of Time 2 well-being with a PROCESS macro for SPSS using 10,000 bootstrapping samples (Hayes 2013). The analyses were conducted separately for the four dependent variables that were employed to assess SWLS, PA, NA, and SV. We conducted the analysis of the indirect effect of the mediator variables following the bootstrapping procedure (Preacher and Hayes 2008). Through this procedure, we resampled the data 10,000 times and calculated the indirect effect for each sample. The resulting output contains the mean indirect effect point estimate, the standard error, and the bias correct (BC) 95% confidence interval (CI) for indirect effect, and it produces unstandardized path coefficients for all paths in the mediation model. Furthermore, the BC 95% CI indicates significant indirect effects if it does not include zero (Preacher and Hayes 2004, 2008; Shrout and Bolger 2002). In addition, we used Preacher and Kelley (2011) and Hayes’s (2013) SPSS PROCESS macro software to calculate the mediational effect size.

Results

The mean, standard deviation, and correlations of the MAAS, GNSS, and all Time 1 and Time 2 well-being variables are presented in Table 1. The Time 1 MAAS was positively correlated with the Time 1 GNSS ($r = 0.34$; $p < 0.01$). The Time 1 GNSS was also found to be positively correlated with the Time 1 SWLS ($r = 0.50$; $p < 0.01$), PA ($r = 0.61$; $p < 0.01$), and SV ($r = 0.65$; $p < 0.01$) and the Time 2 SWLS ($r = 0.57$; $p < 0.01$), PA ($r = 0.58$; $p < 0.01$), and SV ($r = 0.62$; $p < 0.01$), and it was negatively correlated with the Time 1 NA ($r = -0.40$; $p < 0.01$) and Time 2 NA ($r = -0.40$; $p < 0.01$).

Moreover, the Time 1 MAAS was significantly correlated with the Time 2 PA ($r = 0.20$; $p < 0.05$), Time 1 NA ($r = -0.36$; $p < 0.01$), and Time 2 NA ($r = -0.38$; $p < 0.01$). Furthermore, the Time 1 MAAS was found to have non-significant correlations with the Time 1 SWLS ($r = 0.01$; $p = 0.97$), Time 2 SWLS ($r = 0.11$; $p = 0.29$), Time 1 PA ($r = 0.17$; $p = 0.09$), Time 1 SV ($r = 0.13$; $p = 0.21$), and Time 2 SV ($r = 0.08$; $p = 0.43$).

Table 2 shows the results for the GNSS as a mediator variable between the MAAS and Time 2 well-being variables after controlling for the Time 1 well-being variables. First, when controlling for the Time 1 SWLS, we found that the MAAS significantly accounted for the GNSS ($B = 0.30$) but not for the Time 2 SWLS ($B = -0.07$, $p = 0.65$). Moreover, GNSS positively accounted for the Time 2 SWLS ($B = 0.74$). The results of the bootstrapping test indicated that the indirect

Table 1 Descriptive statistics and a correlations matrix of all study variables ($N = 101 \sim 103$)

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. T1MAAS	(.85)												
2. T1Auto	.24	(.64)											
3. T1Comp	.30	.53	(.65)										
4. T1Relate	.28	.47	.59	(.79)									
5. T1GNSS	.34	.80	.86	.82	(.80)								
6. T1SWLS	.01	.50	.42	.32	.50	(.90)							
7. T2 SWLS	.11	.44	.51	.44	.57	.50	(.88)						
8. T1PA	.17	.52	.61	.37	.61	.52	.36	(.89)					
9. T2PA	.20	.38	.54	.51	.58	.32	.62	.50	(.85)				
10. T1NA	-.36	-.44	-.26	-.29	-.40	-.28	-.23	-.22	-.08	(.90)			
11. T2NA	-.38	-.28	-.35	-.35	-.40	-.12	-.38	-.12	-.34	.45	(.90)		
12. T1SV	.13	.65	.54	.44	.65	.55	.48	.70	.48	-.22	-.15	(.86)	
13. T2SV	.08	.55	.54	.45	.62	.38	.64	.49	.74	-.21	-.37	.55	(.84)
M	4.80	5.00	4.53	5.46	4.93	4.25	4.30	4.36	4.67	2.93	3.12	4.03	4.19
SD	0.73	0.80	0.85	0.79	0.68	1.18	1.17	1.04	1.00	1.33	1.12	0.82	0.74

Diagonals are Cronbach's alpha coefficients. Correlations $> .18$ are significant at $p < .05$

T time, MAAS Mindful Attention Awareness Scale, Auto autonomy, Comp competence, Relate relatedness, GNSS General Need Satisfaction Scale, SWLS Satisfaction with Life Scale, PA positive affect, NA negative affect, SV subjective vitality

effect from the MAAS to GNSS and then to the Time 2 SWLS (95% CI 0.09 to 0.42) reached the level of significance.

Second, when controlling for the Time 1 PA, we found that the MAAS significantly accounted for the GNSS ($B = 0.22$) but not for the Time 2 PA ($B = 0.06$, $p = 0.66$). Moreover, GNSS positively accounted for the Time 2 PA ($B = 0.62$). The results of the bootstrapping test indicated that the indirect effect from the MAAS to GNSS and then to the Time 2 PA (95% CI 0.03 to 0.35) reached the level of significance.

Third, when controlling for the Time 1 NA, we found that the MAAS positively and significantly accounted for the GNSS ($B = 0.20$) and negatively accounted for the Time 2 NA ($B = -0.37$). Moreover, we found that the GNSS negatively accounted for the Time 2 NA ($B = -0.37$). The results of the bootstrapping test indicated that the indirect effect from the MAAS to the GNSS and then to the Time 2 NA (95% CI -0.21 to -0.01) reached the level of significance.

Finally, when controlling for the Time 1 SV, we found that the MAAS significantly accounted for the GNSS ($B = 0.24$) but did not significantly account for the Time 2 SV ($B = -0.10$, $p = 0.23$). Moreover, we found that the GNSS positively accounted for the Time 2 SV ($B = 0.53$). The results of the bootstrapping test indicated that the indirect effect from the MAAS to the GNSS and then to the SV (95% CI 0.05 to 0.26) reached the level of significance. The mediational effect sizes in the current study from the Time 1 mindfulness to the Time 2 well-being index via the Time 1 general needs satisfaction are 0.20 for life satisfaction, 0.20 for positive affect, 0.10 for negative affect, and 0.25 for subjective vitality. Based on Preacher and Kelley's (2011) suggestion, the mediational

effect sizes in the current study also represent medium to large effects.

In summary, the results revealed that the indirect effect of the GNSS was significant between the MAAS and well-being indicators (i.e., Time 2 SWLS, Time 2 PA, and Time 2 SV). In addition, when the GNSS was divided into three subscales (autonomy, competence, and relatedness), similar patterns were maintained. Readers interested in detailed results should contact the corresponding author. These results demonstrate indirect-only mediation, whereby a mediation effect occurred despite the absence of a direct association. Moreover, the results revealed that the indirect and direct effects of the GNSS were significant between the MAAS and the Time 2 NA; therefore, it is a complementary mediation. The mediational effect sizes also demonstrated a medium to large effect, thereby supporting the stability of the research results.

Discussion

Through this study, we aimed to investigate the mediation role of basic psychological needs fulfillment between mindfulness and well-being using a two-wave longitudinal design over 5 months. We found that mindfulness predicted longitudinal changes in athletes' life satisfaction, positive affect, negative affect, and subjective vitality that were mediated via basic psychological needs fulfillment. It should be noted that the present study clarified the change of the individual difference at two time points (Stenling et al. 2017), suggested mindful athletes developed a higher well-being relative to less mindful

Table 2 Bootstrap analysis summary indicating the indirect effects of the MAAS on T2 well-being indexes via the GNSS after controlled T1 well-being indexes

Controlled variable	Independent variable (IV)	Mediator variable (MV)	Dependent variables (DV)	a path coefficient (IV-MV)	b path coefficient (MV-DV)	c path coefficient	Mean indirect effect	SE of mean indirect effect	BC 95% CI mean indirect effect (lower and upper)	Effect size
T1SWLS	T1MAAS	T1GNSS	T2SWLS	.30*	.74*	-.07	.23	.08	.09, .42*	.20
T1PA	T1MAAS	T1GNSS	T2PA	.22*	.62*	.06	.14	.07	.03, .35*	.20
T1NA	T1MAAS	T1GNSS	T2NA	.20*	-.37*	-.37*	-.07	.05	-.21, -.01*	.10
T1SV	T1MAAS	T1GNSS	T2SV	.24*	.53*	-.10	.13	.05	.05, .26*	.25

These values are unstandardized path coefficients

T time, MAAS Mindful Attention Awareness Scale, GNSS General Need Satisfaction Scale, SWLS Satisfaction with Life Scale, PA positive affect, NA negative affect, SV subjective vitality

* $p < .05$

athletes over time, and all variances during the time interval changed equally for all athletes. In general, mindful athletes tended to fulfill their basic psychological needs, which thus enhanced their hedonic and eudaemonic well-being compared to less mindful athletes. Therefore, our hypothesis was supported, and it extended the previous study (Chang et al. 2015) by incorporating athlete participants.

The present study expands Chang et al.'s (2015) study because we adopted a longitudinal design to observe the development of athletes' well-being rather than reporting static associations. Furthermore, most of the previous research focused on the cognitive process (Kong et al. 2014; Schutte and Malouff 2011). For example, Garland et al. (2011) conducted a prospective observational study and found that the mindfulness practice broadened awareness, which facilitated positive interpretations of stressful life events and led to substantially reduced distress. However, our study demonstrated another pathway, which is the motivational process. The motivational process suggested that mindfulness clarifies individuals' internal values that fulfill their basic psychological needs and further promote well-being. This result corresponds to the claim that well-being should be pursued to fulfill intrinsic needs rather than to achieve extrinsic standards (Ryan and Deci 2000).

This finding has important theoretical implications because it implies that mindfulness may exert an effect on well-being through different mediators. Indeed, this speculation corresponds to the theoretical model of Birrer et al. (2012) used to investigate mindfulness in sports. Future research needs to further examine other potential motivational mediators, such as achievement goal orientation, because awareness of one's inner state may play a crucial role in people adopting adaptive goal orientation (Akin 2008; McCarthy 2011). Current research has further practical insights for literature on mindfulness in sports psychology. Most of the previous research focused on how mindfulness fosters athletes' competitive performances (Birrer et al. 2012; Gardner and Moore 2012). However, our results remind researchers that athletes with higher levels of mindfulness are associated with having better well-being.

We suggest that future studies use mindfulness interventions to improve athletes' basic psychological needs and further enhance well-being because mindfulness can be manipulated. For example, mindfulness-based stress reduction would foster greater awareness into the nature of one's suffering, and this understanding naturally gives rise to feelings of compassion toward the self and others, which could trigger individuals' relatedness (Creswell 2017; Eberth and Sedlmeier 2012). Moreover, it is suggested that mindfulness-acceptance-commitment therapy together with self-regulatory beliefs would trigger athletes' competence (Bernier et al. 2009). In this regard, those intervention skills that direct athletes to focus on the present moment promote self-monitoring, which

helps athletes to satisfy their basic psychological needs while increasing well-being. However, this speculation requires further investigation.

Limitations

There are several limitations that must be considered. First, although the present study using the two-wave survey can be considered to be a longitudinal design, it is difficult to differentiate true change from measurement errors and impossible to model more complex or non-linear forms of change because of constraints on the degree of freedom (Ployhart and Ward 2011). Therefore, future research should involve collecting at least three waves of data, and more waves are better to study change in a construct (Ployhart and Vandenberg 2010). Second, in the current study, we extrapolate beyond the cross-sectional results and examine patterns of relationships over time. However, it is correlative in nature, and causal effect therefore cannot be determined. Therefore, future research could use an experimental design to manipulate or train mindfulness states and investigate their influence on athletes' psychological processes and outcomes. The third limitation is the self-reporting measurement tool. Although the reliability and validity of self-reporting measures were established, they are sensitive to bias (Podsakoff and Organ 1986; Spector 1994), e.g., social desirability. Future studies using multiple methods, such as peer evaluations or actual behavior outcomes, are recommended.

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Author Contributions WHC: designed and executed the study, assisted with the data analyses, and wrote the paper

LHC: collaborated with the design, assisted with the data analyses, and wrote the paper

LHC and JHC: collaborated with the design and editing of the final manuscript.

Compliance with Ethical Standards

Conflict of Interest Lung Hung Chen has received research grants from the Ministry of Science and Technology (103-22628-H-179-001-MY2), Taiwan, Republic of China. Wen Hsin Chang and Jen-Ho Chang declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Ethical approval for both studies was granted by the National Taiwan University Committee for Ethical Review.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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