

Research article

INFLUENCE OF TEMPERAMENT AND ANXIETY ON ATHLETIC PERFORMANCE

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ABSTRACT

Our research aimed to conduct basic descriptions of temperamental traits and the level of state and trait anxiety of young male athletes, and to compare them by type of sports. Study participants were 277 athletes and 152 non-athletes who were all high school boys. The Korean version of the Temperament and Character Inventory (TCI) was used for checking temperamental traits while the Korean version of the State and Trait Anxiety Inventory form Y (STAI-KY) was used to estimate anxiety levels. Harm Avoidance score of athletes was higher than that of non-athletes. Harm Avoidance score of golfers was lowest and that of swimmers was highest. The state anxiety score of baseball players was lowest and that of Taekwondo players was highest. The trait anxiety score of baseball players was also lowest and that of golfers was highest. Both trait and state anxieties of the 'winner' group were lower than those of the 'no winner' group. While prior research mainly focused on athletes' environment and phenotypic characteristics, we studied the pattern of temperaments in athletes along with its potential influence on athletic performance.

KEY WORDS: Temperament, TCI, state, trait, anxiety, performance.

INTRODUCTION

The genetic markers with evidence of association or linkage with a performance or fitness phenotype in active people, in adaptation to acute exercise, or for training-induced changes have been reported to be related with the genetic map of all autosomes and the X chromosome (Wolfarth, 2005). Also, there seems to be some factors that derive the overall development of athletic body and mind (Begel, 1992). According to the Lane and Terry (2000), affective states have been considered as important factors in physical activity and exercise.

In addition, have been known to be more sensitive to stress than non-athletes, when they met the condition of separation and loss (Little, 1969). Watson and Pulford (2004) found that amateur athletes scored higher on Extroversion and lower on Neuroticism in personality and higher on Psychoticism. Several studies have shown a link between personality and outcomes including performance (Judge, 1998; Tokar et al., 1998), career success (Hanson, 1967) and job satisfaction (Hellstadt, 1987). According to the Eysenck's study (1982), several factors including sports type, the playing position in the team, and the level of

performance should be considered in conducting the research regarding associations between personality and physical exercise.

Based on previous findings, we planned to assess the temperamental patterns of athletes. The Temperament and Character Inventory (TCI) developed by Cloninger (1986) was used to evaluate the temperamental traits of Harm Avoidance (HA), Novelty Seeking (NS), Reward Dependence (RD) and Persistence. The possible underlying genetic and neuroanatomical bases of the observed variation in these dimensions were reviewed and considered in relation to adaptive responses to environmental factors.

Those four factors have temperamental characters which are genetically independent from one another, moderately heritable, and stable across time (Cloninger et al., 1991). Usually, Novelty Seeking is related with behavioral activation, impulsivity, and quick tempered, while Harm Avoidance is associated with behavioral inhibition, cautiousness, and apprehensiveness. Reward Dependence explained continuing behaviors that have been previously associated with reinforcement and maintained on other's approval. Finally, persistence involves a heritable bias towards continuing and persevering without reward.

Cloninger et al. (1993) proposed that each temperament dimension is controlled by neurotransmitter in a complex network of brain connections: Novelty Seeking is regulated by dopaminergic activity and Harm Avoidance and Reward Dependence are controlled by serotonergic and noradrenergic activity. In accordance with Cloninger's model, Positron Emission Tomography studies shown that 'Novelty Seeking (behavioral activation)' was related to dopamine system in normal person and substance abusers (Compton et al., 1996; Suhara et al., 2001; Wiesbeck et al., 1995). In addition, Peirson et al. (1999) suggested that serotonin system was associated with Harm Avoidance (behavioral inhibition).

According to prior reports that stress seemed to be associated with psychological dysfunction and drop-outs, the estimation of sports-related anxiety for young athletes would be valuable in finding out a hazard factor to athletes' performance and a help in promoting strategies that may alleviate psychological stress during sports activities (Ommundsen, 1992; Robinson and Carron, 1982).

The Spielberger's State-Trait Anxiety Inventory (STAI) has been widely used for estimating anxiety (Spielberger, 1966). In STAI, state anxiety is an emotional state consisting of fear or apprehension while trait anxiety refers to a predisposition to perceive situations as potentially

threatening (Spielberger, 1966). In similar dynamic, we speculated that anxious athletes with distorted perception would be more sensitive and irritable in competitive arenas.

The current study aimed to make a basic description of temperamental trait and the level of state and trait anxiety in young male athletes. We also compared differences in anxiety and personality by the type of sports.

METHODS

Participants

Study participants were 277 athletes and 152 non-athletes who were all boys at high schools (mean age = 17.36 ± 2.99). Athletes were selected from the roster of Korean Sport Council & Korean Olympic committee (KSC & KOC) division high schools in Seoul, Kyungki, and Kangwon, South Korea. The protocol of this study was approved by the Ethics Committee of Chun-Cheon National Hospital. For the screening of psychiatric problems, Symptom Checklist-90-Revision (Kim et al., 1984) was used. Type of sports was classified according to Bäckmand et al.'s classification (Bäckmand et al., 2001): anerobicity (aerobic, anaerobic, or both); team versus individual sports. Other classification includes: endurance [long distance running ($n = 22$)], combat power sports [Taekwondo ($n = 28$), Korean wrestling, i.e., Ci-reum ($n = 20$), and Judo ($n = 47$)] and individual power sports [throwing sports ($n = 29$) including javelin, discus, shot put], swimming ($n = 27$), and golf ($n = 38$). Team sports included soccer ($n = 20$), baseball ($n = 28$) and rugby ($n = 18$). Athletes were also divided into the 'winner' group ($n = 110$), who had the experience of the 1st or final winner and 'no winner' group where athletes have not had that winning experience ($n = 167$).

Measures

Trait analysis

The Korean version of the TCI was used (Sung et al., 2002). It consisted of 240-items of true/false questionnaires to evaluate four dimensions of temperament and three dimensions of character. The reliability of this tool had previously been reported (Sung et al., 2002). In accordance with the aims of this study, we analyzed only four temperament dimensions as indicated.

Anxiety analysis

The Korean version of the STAI form Y (STAI-KY) was used to estimate state and trait anxiety levels (Cho, 1989). In this scale, 40 questions about anxiety classified into two factors, state anxiety with

Table 1. Demographic and sport-related characteristics in athletes and non-athletes. Data are means (\pm SD).

Type of sports	sample size	age (years)*	duration (years)*	winning experience**
Endurance sports				
Long distance running	22	17.5 (.7)	4.5 (1.0)	8
Power sports/combat	95	17.6 (.7)	4.8 (.1)	34
Taekwondo	28	17.9 (.5)	5.3 (.9)	12
Cireum	20	17.4 (.6)	4.8 (1.6)	8
Judo	47	17.7 (1.0)	4.4 (.8)	14
Power sports/individual	94	17.6 (.8)	4.4 (.4)	38
Throwing	29	17.7 (.5)	4.5 (1.6)	15
Swimming	27	17.6 (.6)	4.3 (1.2)	9
Golf	38	17.4 (1.1)	4.4 (1.2)	14
Team sports	66	17.6 (.8)	4.6 (.9)	30
Soccer	20	17.4 (.6)	5.1 (.9)	8
Rugby	18	17.6 (.8)	4.3 (.9)	6
Baseball	28	17.9 (1.0)	4.5 (.9)	16
Non athletes	152	17.9 (.8)	-	-

* ANOVA : $p > 0.05$, ** χ^2 -test : $p > 0.05$.

Duration: duration of athletic experiences, winning experience: the number of the winning experience in the final match or 1st in his major.

20 items and trait anxiety with 20 items.

Analysis of data

Demographic and clinical variables involving continuous and categorical data were compared using independent t-tests and chi-square tests, respectively. TCI and anxiety of athletes were compared according to the type and classification of sports. The correlation of anxiety with TCI was tested with Pearson correlation analysis. Logistic regression models were used to see whether anxiety, four domains of TCI and the duration of participating in sports could predict the 'winning' experience. Statistical significances were defined at an alpha level of 0.05 and two tailed.

RESULTS

Demographic characteristics

There were no significant differences of demographic variables between the athletes and non-athletes with regard to age, duration of participating in sports, and frequency of being a winner (Table 1).

TCI characteristics in athletes

Harm Avoidance score of athletes was higher than that of non-athletes while there were no differences in other temperaments between groups (18.2 ± 5.9 and 16.7 ± 5.9 , respectively). Endurance sports showed highest Novelty Seeking (23.0 ± 3.7) and lowest Persistence score (3.2 ± 1.6) among four

types of sports (endurance, power/combat, power/individual, and team sports) (Table 2). Specifically, Taekwondo players (17.1 ± 3.1) were lowest and throwers (24.2 ± 6.4) were highest in Novelty Seeking. Long distance runners (3.2 ± 1.6) were lowest and Ci-reum (6.0 ± 0.7) players were highest for Persistence (Table 2). Golfers (14.7 ± 6.3) were lowest and swimmers (21.7 ± 3.9) were highest in Harm Avoidance.

Characteristics of anxiety in athletes (Table 2)

Levels of both trait and state anxiety of the athletes were higher than those of non-athletes. The state and trait anxiety scores of team sports were lower than that of any of the other three main type of sports ($p < 0.05$). When state anxiety was compared among each type of sports ($p < 0.05$): the state anxiety score of baseball players was lowest. This value was even lower than that of non-athletes. Taekwondo players had highest state anxiety levels.

When trait anxiety was compared among each type of sports ($p < 0.05$): Baseball players had lowest trait anxiety while golfers had highest scores.

Correlation of anxiety levels and scales of TCI (Table 3)

In the athlete group, trait anxiety was correlated with state anxiety. Harm Avoidance was correlated with both state and trait anxieties. In the power/combat sports group, Reward Dependence was correlated with state anxiety. In power/individual sports group, Harm Avoidance was related with state anxiety.

Table 2. Characteristics of anxiety and Temperament and Character Inventory in athletes. Data are means (\pm SD).

Sports	Anxiety		Temperament and Character Inventory			
	State	Trait	NS	HA	RD	P
Endurance sports						
long distance running	53.3 (12.6)	46.8 (11.8)	23.0 (3.7)	18.4 (5.3)	13.7 (3.3)	3.2 (1.6)
Power sports /combat						
Taekwondo	52.5 (14.4)	50.5 (12.0)	19.5 (4.8)	18.6 (5.7)	14.9 (3.4)	4.9 (1.5)
Cireum	57.4 (14.3)	53.4 (11.8)	17.7 (3.1)	20.3 (4.2)	15.9 (3.1)	5.1 (1.4)
Judo	54.4 (13.3)	53.6 (9.3)	21.3 (7.3)	15.6 (6.8)	15.2 (3.9)	6.0 (.7)
Power sports /individual						
Throwing	48.9 (14.2)	47.4 (12.6)	19.9 (4.3)	18.9 (5.6)	14.1 (3.2)	4.3 (1.6)
Swimming	50.8 (11.6)	53.9 (14.9)	20.5 (5.6)	17.7 (6.3)	14.5 (3.2)	4.3 (1.9)
Golf	48.1 (12.8)	46.7 (12.1)	24.2 (6.4)	17.6 (6.0)	15.4 (4.1)	3.9 (1.9)
Team sports						
Soccer	54.9 (12.2)	54.7 (19.5)	18.1 (3.2)	21.7 (3.9)	13.8 (1.6)	3.7 (1.9)
Rugby	49.9 (9.4)	58.9 (10.7)	19.2 (4.8)	14.7 (6.3)	14.3 (2.9)	5.2 (1.5)
Baseball	41.5 (11.7)	43.0 (12.7)	19.8 (5.9)	18.4 (5.9)	15.3 (3.5)	4.5 (1.9)
Athlete total						
	44.0 (9.4)	48.9 (11.6)	19.8 (4.5)	18.6 (5.6)	16.3 (2.8)	4.7 (2.1)
Non athlete						
	48.9 (13.9)	46.1 (14.8)	22.4 (5.4)	19.4 (5.8)	13.5 (3.6)	3.8 (1.9)
	35.1 (7.8)	38.3 (10.7)	18.1 (6.6)	17.7 (6.3)	15.7 (3.5)	4.9 (1.9)
Athlete total						
	49.4 (13.4)	49.8 (13.8)	20.3 (5.3)	18.2 (5.9)	14.8 (3.3)	4.5 (1.8)
Non athlete						
	41.8 (7.2)	42.4 (7.4)	20.4 (5.5)	16.7 (5.9)	14.7 (3.2)	4.2 (1.8)

TCI: Temperament and Character Inventory, NS: Novelty Seeking, HA: Harm Avoidance, RD: Reward Dependence, P: persistence.

Reward Dependence was negatively correlated with state and trait anxiety. Persistence was correlated with trait anxiety. In the team sports group, NS was correlated with state anxiety. Harm Avoidance was correlated with both state and trait anxieties. Persistence was negatively correlated with trait anxiety.

Comparison of anxiety levels and TCI between 'winner' group and 'no winner' group (Table 4)

'Winner' group (n = 110) means athletes who had the experience of being the most valuable player (MVP), the best player in his position or the final winner in his sports category. In contrast, "no winner" (n = 167) group means athletes who did not

have those experiences. The matches or games in which athletes participated included 1) the yearly Korean national sports festival for adolescents, 2) the quarterly Korean national tournament for high school students, and 3) the bimonthly 'association cups' for adolescents that were supported by the Korean Sport Council and Korean Olympic committee. In the team sports, the 'winner' group was limited to the best eleven or nine depending on sports category. The duration of participating in sports and frequency of winner experience in winner group were 4.16 ± 1.13 years and 3.39 ± 1.82 . In all athlete groups, 'winner' group had lower trait and state anxieties than 'no winner' group (winner vs no winner: 47.8 ± 13.4 vs 51.4 ± 14.1 , by 7.5%; 47.0

Table 3. Pearson correlation coefficients (r) between anxiety and scales of Temperament and Character Inventory (TCI) in athletes.

	all athletes		endurance sports		power/combat sports		power/individual sports		team sports	
	State	Trait	State	Trait	State	Trait	State	Trait	State	Trait
State	-	.73**								
Trait	.73**	-	.76**	-	.77**	-	.74**	-	.64**	-
NS	-.04	-.025	-.30	-.40	-.19	-.01	-.16	-.21	.30**	.24
HA	.28**	.18**	.78**	.49*	.16	.06	.29**	.17	.39	.35**
RD	-.06	-.13*	-.34	-.24	.22*	.09	-.22*	-.23*	-.12	.16
P	-.07	.08	-.13	.28	.04	.20	.01	.27**	-.28	-.32**

* $p < 0.05$, ** $p < 0.01$. State: state anxiety, Trait: trait anxiety, NS: Novelty Seeking, HA: Harm Avoidance, RD: Reward Dependence, P: persistence.

Table 4. State and trait anxiety levels and patterns of biogenetic temperament between athletes with and without winning experience. Data are means (\pm SD).

	Winner	No winner	Statistics	
	(n = 110)	(n = 167)	t	p
State anxiety	47.0 (15.2)	50.7 (12.1)	2.13	.03 *
Trait anxiety	47.8 (13.4)	51.4 (14.1)	1.99	.04 *
Novelty Seeking	19.9 (5.2)	19.7 (5.2)	.48	.63
Harm Avoidance	18.1 (5.5)	18.5 (6.5)	.58	.56
Reward Dependence	15.4 (3.2)	14.4 (3.3)	2.41	.02 *
Persistence	4.9 (1.8)	4.4 (1.8)	2.29	.02 *

* p < 0.05. Winner: athletes who had the experience of the 1st or the final winner.

\pm 15.2 vs 50.7 \pm 12.1, by 7.8%, respectively). Reward Dependence and Persistence score of the winner group were higher than those of no winner group (winner vs no winner: 15.4 \pm 3.2 vs 14.4 \pm 3.3; 4.9 \pm 1.8 vs 4.4 \pm 1.8, respectively). The predictors for the winner group were Persistence of the TCI temperaments and the duration of participating in sports of sports-related history (odd ratio (OR) = 1.17, p = 0.02 and OR = 1.29, p = 0.03, respectively).

In the endurance sports group, the identification of predictors for the winner group could not be performed in the regression analyses due to the small sample size. In power/combat sports group, the predictors for the winner group were Novelty Seeking of TCI and trait anxiety at a marginally significant level (OR = 1.19, p < 0.01 and OR = 0.95, p = 0.04, respectively, Table 5).

In power/individual sports group, the predictor items for the winner group were Persistence of TCI trait anxiety (at a marginal level) and the duration of participating in sports (OR = 1.25, p = 0.01; OR = 0.96, p = 0.03; OR = 1.51, p = 0.03, respectively, Table 5).

DISCUSSION

In our research, the athletes group showed higher Harm Avoidance scores than non-athlete group.

Individuals who are higher than average in Harm Avoidance are characterized as cautious, fearful, inhibited and apprehensive (Cloninger, 1986). These traits are thought to reflect variation in punishment and behavioral inhibition system of the brain (Cloninger, 1986; Cloninger et al., 1993). This result was related with Cooper's report (1969) and Saint-Phrad et al.'s (1999) assumption. Cooper (1969) suggested that athletes wanted higher degree of emotional stability and seemed more socially adjusted compared with non-athletes. According to Saint-Phrad et al., athlete's low competence score reflected a self-critical or perfectionistic style that athletes resorted to measure their athletic abilities and, possibly, themselves. Taken together, we can suggest that athletes may have the fragile trait which is sensitive to punishment and blame.

It is noteworthy that long distance runners had highest Novelty Seeking and lowest Persistence score than athletes in any other main sports groups. Individuals who had higher Novelty Seeking scores were impulsive, explorative, fickle, excitable and quick-tempered (Cloninger, 1986; Cloninger et al., 1993). These results, however, were different to those from previous studies. Morgan et al. (1988) found that male distance runners suffered less from stress, depression, anger, and tiredness than an average person. Egloff and Gruhn (1996) proposed that endurance athletes had extroversive and

Table 5. Predictor items for the winning experience in the regression models

Athlete group	Team sports			Power/combat sports			Power/individual sports					
	B	Wald	p	B	Wald	p	B	Wald	p	B	Wald	p
STATE	-.00	0.02	.90	-.05	1.89	.17	.06	.03	.10	.006	.04	.86
TRAIT	-.02	1.45	.23	.03	1.28	.26	-.09	.04	.04	-.070	.03	.03
NS	.02	.53	.47	-.06	1.34	.25	.19	.07	<.01	.092	.06	.11
HA	.04	2.86	.09	.02	.09	.77	.08	.05	.14	.060	.04	.20
RD	.05	1.35	.25	.09	1.09	.29	.13	.09	.13	-.039	.08	.63
P	.19	5.29	.02	.09	.29	.59	.29	.19	.12	.532	.20	.01
His.	.26	4.91	.03	.47	2.43	.12	.09	.23	.71	.476	.21	.03

NS: Novelty Seeking, HA: Harm Avoidance, RD: Reward Dependence, P: Persistence, His.: the duration of participating in sports of sports-related history.

sociable trait, which may influence the choice of sport). Extroversion is characterized by sociable, controlled impulsiveness, and optimistic (Watson and Pulford, 2004). Bäckmand et al. (2001) insisted that endurance sport athletes had lower neuroticism scores than other sport athletes. Although this discrepancy might be due to the cohort effect of our long distance runners as well as differences of trait anxiety and environment, we think that the NS trait of pursuit of potential rewards and active avoidance of monotony may make the athlete run in boring and monotonous track.

Bäckmand and Kazen (1994) reported that controlled type sport athletes with high demands on energy regulation (long-distance runners and rowers) suffer from failure-related state orientation or the failure motive. This tendency may be related with Novelty Seeking trait in our study participants, since higher Novelty Seeking individuals easily lose volition when their needs are not met (Cloninger, 1986; Cloninger et al., 1993).

In power/combat sports group, the Novelty Seeking trait of impulsiveness, excitability, and exploration were comparable to that in O'sullivan's report (O'sullivan et al., 1998). They showed that body contact sports participants showed high sensation-seeking and aggressiveness.

In the current study, the athletic group had higher trait anxiety than non-athletes. This trait anxiety was correlated with Harm Avoidance (Cloninger, 1986; Cloninger et al., 1993). This result was in line with a previous report that athletes were more emotionally stable than controls, but had higher neuroticism and anxiety (Mäkelä, 1974).

The trait and state anxieties of team sports players were lower than any other sports groups. While HA was positively correlated with trait anxiety level (Cloninger, 1986; Cloninger et al., 1993), HA scores were not different among four main sports groups.

Men with higher Harm Avoidance trait have been reported to have lower energy level and tendency to be easily fatigable, and to require more support and response (Cloninger, 1986). It is in line with the report of O'Sullivan et al. (1998). They found that athletes in team sports had higher activity and lower neuroticism-anxiety levels than a general college population. It might be due to environmental factors which could affect and interplay with the temperamental trait of team sports athletes. The role of team members, and changes in roles/playing position, for example, may provide more frequent personal interactions between team members. These contacts may provide the proper emotional support (Eysenck et al., 1982).

In the power/individual sports group, Reward Dependence was negatively correlated with trait anxiety. Individuals with higher Reward Dependence were characterized as being eager to please others, warmly sympathetic and dependent on others (Cloninger, 1986). Athletes of individual power sports were reported to be more introverted than other groups (Bäckmand et al., 2001). Hanson (1967) found that individual sports, which naturally involve evaluations for individual performance than team sports, have provoked higher stress responses prior to competitions. Consequently, our study results might suggest that athletes in individual sports would be more prone to be anxiety levels. Specially, in the golf, we found high anxiety level. Anxiety had been regarded as the important factor which divided three forms (optimal, choking, and panic) of performance failure in golf (Terrence et al. 2005)

In the current study, both trait and state anxieties of the winner group were lower than those of the no winner group. This result was in line with Halvari and Gjesme's (1995) report. They suggested that trait anxiety was related to both pre-state anxiety and performance errors. Hajcak et al. (2003) proposed that participants with high general anxiety and worry have higher error-related brain activity relative to both phobic and non-anxious control participants.

Reward Dependence and Persistence scores of the winner group were higher than those of the no winner group. Individuals with high Reward Dependence were characterized as persistent, industrious, sensitive social cues and personal succor but able to delay gratification with the expectation of eventually being rewarded (Cloninger, 1986). This finding was associated with Ewing et al.'s (1987) and Maehr and Nicholls' reports (1980). Ewing et al. found that many elite athletes reported that they participate in sports in order to please others and to get social approval. Maehr and Nicholls argued that the achievement goal of social approval-oriented athletes was to gain approval from others for trying hard to accomplish the tasks.

Our results showed that the predictor item for the winning experience in all athletes and team sports group was the Persistence of TCI are in accord with Cloninger's report (1986) that individuals with higher Persistence were characterized to continuously conduct tasks without immediate successive reward or boosting.

Limitations of study

First, the sample size was not sufficient enough to demonstrate characteristics of a number of athletic

groups. Especially for the endurance sports, which had the smallest sample size ($n = 22$, 7.9%) among our sports groups, our finding (Higher Novelty Seeking and lower Persistence trait) was not in line with previous results (trait of lower Novelty Seeking and higher Persistence). Second, multiple comparisons had been conducted. Consequently, readers should be cautious in interpreting positive findings of the current study. Third, underlying psychiatric problems and self medication for controlling anxiety might affect the choice of sport in spite of the screening of Symptom Checklist-90-Revision. Finally, the fact that the choice of sports by athletes has also been influenced by cultural, environmental, and familiar background was not taken into account in the current study (Sage, 1989).

Strength of the study

While prior research mainly focused on athletes' environment and phenotypic characteristics, we studied the pattern of biogenic temperament in athletes along with its potential relationship with athletic performance. Also, the level of state and trait anxiety was described. Our preliminary data may potentially be helpful in designing strategies for caring and supporting athletes and coaches. Our preliminary data may potentially be helpful in designing strategies for caring and supporting athletes. Future long-term studies are recommended to follow up how the type of sport influence or fortify the participant's traits.

CONCLUSION

Temperamental patterns of athletes have influences on the anxiety level and athletic performances.

REFERENCES

- Bäckmand, H., Kaprio, J., Kujala, U. and Sarna, S. (2001) Personality and mood of former elite male athletes—a descriptive study. *International Journal of Sports Medicine* **22**, 215-221.
- Beckmann, J. and Kazen, M. (1994) Action and state orientation and the performance of top athletes. In: *Volition and personality: action versus state orientation*. Eds: Kuhl, J. and Beckmann, J. Seattle: Hogrefe & Huber. 439-451.
- Begel, D. (1992) An overview of sport psychiatry. *American Journal of Psychiatry* **149**, 609-614.
- Brewer, B.W. (1998) A developmental overview of child and youth sports in society. In: *Child and adolescent psychiatric clinics of North America: Sport psychiatry*. Ed: Tofler, I.R. Philadelphia: Saunders. 697-724.
- Cho, S.C. (1989) Assessment of Test Anxiety. *Journal of Korean Neuropsychiatry* **28**, 668-677.
- Cloninger, C.R. (1986) A systematic method for clinical description and classification of personality variants. *Archives of General Psychiatry* **44**, 573-588.
- Cloninger, C.R., Przybeck, T. and Svrakic, D.M. (1991) The tridimensional personality questionnaire: US normative data. *Psychological Report* **69**, 10147-10157.
- Cloninger, C.R., Svrakic, D.M. and Przybeck, T.R. (1993) A psychobiological model of temperament and character. *Archives of General Psychiatry* **50**, 975-990.
- Compton, P.A., Anglin, M.D., Khalsa-Denison, M.E. and Paredes, A. (1996) The D2 dopamine receptor gene, addiction, and personality: clinical correlates in cocaine abusers. *Biological Psychiatry* **39**, 302-324.
- Cooper, L. (1969) Athletics, activity and personality: a review of the literature. *Research Quarterly* **40**, 17-22.
- Egloff, B. and Gruhn, J. (1996) Personality and endurance sports. *Personality and Individual Differences* **21**, 1223-1229.
- Ewing, M.E., Feltz, D.L., Schultz, T.D. and Albrecht, R.R. (1987) Psychological characteristics of competitive young hockey players. In: *Effects of Competitive Sports in Children and youth: Proceeding from the 1985 CIC symposium*. Eds: Brown, E and C. Branta, C., Champaign, IL: Human Kinetics.
- Eysenck, H.J., Nias, D.K.B. and Cox, D.N. (1982) Sport and personality. *Advances in Behavior Research and Therapy* **4**, 1-56.
- Finkenberg, M.E., Mitchell, C.B. and Weems, S. (1991) Self-concepts of elite female collegiate athletes: preliminary analysis. *Perceptual and Motor Skills* **73**, 509-510.
- Hajcak, G., McDonald, N. and Simons, R.F. (2003) Anxiety and error-related brain activity. *Biological Psychology* **64**, 77-90.
- Halvari, H. and Gjesme, T. (1995) Trait and state anxiety before and after competitive performance. *Perceptual and Motor Skills* **81**, 1059-1074.
- Hanson, D.L. (1967) Cardiac response to participation in little league baseball competition as determined by telemetry. *Research Quarterly* **38**, 384-388.
- Hellstadt, J.C. (1987) The coach/parent/athlete relationship. *Sport Psychologist* **1**, 151-160.
- Judge, T.A., Locke, E.A., Durham, C.C. and Kluger, A.N. (1998) Dispositional effects on job and life satisfaction: The role of core evaluations. *Journal of Applied Psychology* **83**, 17-34.
- Kim, K.I., Kim, J.H. and Won, H.T. (1984) *Korean manual of Symptom Checklist-90-Revision*. Seoul: Jung Ang Juk Sung Publisher. 8-10.
- Lane, A.M. and Terry, P.C. (2000) The nature of mood: Development of a conceptual model with a focus on depression. *Journal of Applied Sport Psychology* **12**, 16-33
- Little, J.C. (1969) The athlete's neurosis—a deprivation crisis. *ACTA Psychiatrica Scandinaviaca* **45**, 187-197.

- Maehr, M.L. and Nicholls, J.G. (1980) Culture and achievement motivation: a second look. In: *Studies in cross-cultural psychology*. Ed: Warren, N. New York: Academic Press.
- Mäkelä, S. (1974) *The Finnish top-level athlete of 1971. A psychiatric study of male representatives of five branches of sport*. Helsinki Finland: Helsinki University Central Hospital. Psychiatric Clinic.
- Morgan, W.P., O'Connor, P., Ellickson, K. and Bradley, P. (1988) Personality structure, mood states and performance in elite male distance runners. *International Journal of Sport Psychology* **19**, 247-263.
- O'sullivan, D., Zuckerman, M. and Kraft, M. (1998) Personality characteristics of male and female participants in team sports. *Personality and Individual Differences* **25**, 119-128.
- Ommundsen, Y. (1992) *Self evaluation, affect and dropout in the soccer domain: A prospective study of young male Norwegian players*. Thesis. Oslo, Norway: The Norwegian University of Sport & Physical education.
- Peirson, A.R., Heuchert, J.W., Thomala, L., Berk, M., Pleain, H. And Cloninger, C.R. (1999) Relationship between serotonin and the temperament and character inventory. *Psychiatry Research* **13:89(1)**, 29-37.
- Robinson, T.T. and Carron, A.V. (1982) Personal and situational factors associated with dropping out versus maintaining participation in sport. *Journal of Sport Psychology* **4**, 364-378.
- Sage, G.H. (1989) Becoming a high school coach: from playing sports to coaching. *Research Quarterly for Exercise and Sport* **60**, 81-92.
- Saint-Phard, D., Dorsten, B.V., Marx, R.G. and York, K.A. (1999) Self-perception in elite collegiate female Gymnasts, cross-country runners, and track-and-field athletes. *Mayo Clinic Proceeding* **74**, 770-774.
- Spielberger, C.D. (1966) Theory and research on anxiety. In: *Anxiety and behavior*. Ed: Spielberger New York: Academic Press.
- Suhara, T., Yasuno, F., Sudo, Y., Yamamoto, M., Inoue, M., Okubo, Y. and Suzuki, K. (2001) Dopamine D2 receptors in the insular cortex and the personality trait of novelty seeking. *Neuroimage* **13**, 891-895.
- Sung, S.M., Kim, J.H., Yang, E., Abrams, K.Y. and Lyoo, I.K. (2002) Reliability and validity of the Korean version of the temperament and character inventory. *Comprehensive Psychiatry* **43**, 235-243.
- Terrence, P.C., Ian R.T. and Michael T.L. (2005) The Sport Psychiatrist and Golf. *Clinics in Sports Medicine* **24**, 959-971.
- Tokar, D.M., Fischer, A.R. and Subich, L.M. (1998) Personality and vocational behavior: a selective review of the literature, 1993-1997. *Journal of Vocational Behavior* **53**, 115-119
- Watson, A.E. and Pulford, B.D. (2004) Personality differences in high risk sports amateurs and instructors. *Perceptual and Motor Skills* **99**, 83-94.
- Wiesbeck, G.A., Maurer, C., Thome, J., Jakob, F. and Boening, J. (1995) Neuroendocrine support for a relationship between "novelty seeking" and dopaminergic function in alcohol-dependent men. *Psychoneuroendocrinology* **20**, 755-761.
- Wolfarth, B., Bray, M.S., Hagberg, J.M., Perusse, L., Rauramaa, R., Rivera, M.A., Roth, S.M., Rankinen, T. and Bouchard, C. (2005) The human gene map for performance and health-related fitness phenotypes: the 2004 update. *Medicine & Science in Sports & Exercise* **37**, 881-903.

KEY POINTS

- Harm Avoidance score of athletes was higher than that of non-athletes.
- Harm Avoidance score of golfers was lowest and that of swimmers was highest.
- Both trait and state anxieties of the 'winner' group were lower than those of the 'no winner' group.
- The trait anxiety score of baseball players was also lowest while that of golfers was highest.

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