Original Article

Effects of self-control on the tolerance to high-intensity exercise

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ABSTRACT

High-intensity exercise has efficient elements such as time saving and metabolic benefits, while it is physiologically demanding, and requires stronger mental capacity than traditional exercise regimens. The present study aimed to examine differences in exercise intensity relative to self-control in exercise participants. Participants completed the multistage 20 m shuttle run test (MST) in an indoor gymnasium under the same environmental condition. Participants (*N* = 81; male *n* = 55; Mage = 23.06 years) completed measures of self-control and motivation for participation in aerobic exercises. Additionally, heart rate, high-intensity exercise volume, and perceived exertion were used to measure exercise intensity. Self-control has a significant positive correlation with several variables that measure exercise intensity. In addition, hierarchical regression analyses showed that trait self-control positively and significantly predict exercise intensity after controlling for self-determined motivation. Trait self-control is a significant psychological variable to account for behaviours related to high-intensity exercise and it might be more important for the tolerance the exercise intensity than one's self-determined motivation to it.
Keywords: Exercise psychology; Health behaviour; Public health.

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INTRODUCTION

High-intensity exercises are commanding increasing attention by exercise participants who are prioritizing the efficiency of their exercise routine. The American College of Sports Medicine (Garber et al., 2011) has stressed the efficiency of high-intensity exercises with 75 minutes of high-intensity physical activities per week being equivalent to 150 minutes of moderate-intensity exercises. Buoyed by recent research findings that high-intensity exercise may be more effective because it requires less time to gain similar benefits than moderate-exercise(Kessler, Sisson, & Short, 2012). Thus, high-intensity exercise is emerging as a desirable alternative to low- to moderate intensity activities.

Despite these benefits, high-intensity exercise has been criticized for that many people are not willing to participate in such hard exercise (Biddle & Batterham, 2015). Some existing studies even suggested that there is negative relationship between exercise intensity and adherence(Cox, Burke, Gorely, Beilin, & Puddey, 2003; Perri et al., 2002). This is associated with that severe intensity exercise involves excessive physical and psychological stress. Thus, understanding different factors related to overcome the stressful aspects would be beneficial for explain the participation and adherence in high intensity exercise.

To understand exercise behaviours in high intensity, research is needed to identify the willpower required to overcome physical and psychological stress in vigorous physical activity. One possible characteristic is self-control. Self-control is the ability to resist impulses or temptation that interfere with achieving one's goals (Tangney, Baumeister, & Boone, 2004), and has been cited as a crucial factor for maintaining and sustaining certain activities, including, smoking cessation, dieting, exercising, and studying (Baumeister, Gailliot, DeWall, & Oaten, 2006). Trait self-control has been identified as one possible psychological variable that can promote healthy activities including exercising (Dishman & Sallis, 1994; Hagger, Wood, Stiff, & Chatzisarantis, 2010) since it enables individuals to set an objective and work toward their objective while deliberately suppressing the behaviours deemed inappropriate to them (Baumeister, Vohs, & Tice, 2007). People with low trait self-control may behave impulsively and make hasty decisions in the face of physical and psychological stress (Lewinsohn & Mano, 1993), or may experience failure in sustaining certain behaviours (Baumeister & Heatherton, 1996). Previous research has reported that physiological reactions to exercising, including elevated heart rate or blood pressure, can cause ego depletion, requiring participants to exert self-regulatory efforts to continue exercising (Segerstrom & Nes, 2007; Wright et al., 2007). This might imply that the participation in high intensity exercise requires strong self-control as induces such physical distress.

From the findings of existing studies about exercise engagements, an individual`s willpower would be considered as an important factor for engagement in high intensity exercise. The reason why people tend to avoid doing strenuous exercise may be that higher intensity exercise typically induce negative feelings with physical stress and pain during the activity (Hall, Ekkekakis, & Petruzzello, 2005). Thus, execution of high intensity exercise require tolerance to metabolic stress and unpleasant emotion induced from the activity including psychological or cognitive exertion.

In this regard, Borg (Borg, 1982) suggested the rating of perceived exertion (RPE) to measure the physiological and psychological stress perceived by individuals during exercise. Participants feel the urge to stop exercising when the subjective intensity of the exercise (i.e., the RPE) is high (Borg, 1982). Rejeski (Rejeski, 1985) noted that perceived exertion is a subjective variable and thus closely associated with psychological factors. Literature on RPE has reported that physiological reactions to exercises (e.g., heart rate, respiration rate, oxygen uptake, blood lactate) and subjective RPE scales are not perfectly correlated

(Hall et al., 2005). These findings highlight the importance of psychological characteristics or traits such as self-control within an individual that are needed to engage in a high-intensity exercise regimen.

In the hyperbolic discounting model of impulsiveness (Ainslie, 1975), self-control is considered as the choice of delayed but larger rewards, over immediate but smaller rewards. That is, the core concept of self-control is to control impulsiveness and immediate responses, which is in line with the delay of gratification concept (Mischel, Shoda, & Rodriguez, 1989). According to the self-regulatory strength model of self-control (Baumeister, 2002; Baumeister & Heatherton, 1996), it takes exertion and willpower to regulate one`s behaviours or emotions by controlling such impulsivity using self-control which is depletable and limited resources. Thus, self-control can be defined as the capacity of regulating one`s behaviours and emotions, and this ability is helpful to inhibit undesirable behaviours and facilitate desirable behaviours through tolerating immediate impulses with efforts and willpower.

Earlier research related to the promotion of high-intensity exercise have mainly focused on considering participants` motivation as a key cognitive element for the tolerance of severe intensity in exercise behaviours. Biddle and Batterham[3] insist that engagement in high intensity exercise requires high levels of motivation because there is no inherent drive in persistent physical activity or exercise. In addition, some studies identified that motivational factors positively influence tolerance or adherence to high-intensity exercise (Pessiglione et al., 2007; Thøgersen-Ntoumani, Shepherd, Ntoumanis, Wagenmakers, & Shaw, 2016; Vøllestad, 1997). However, even highly motivated people who engaged in regular exercise could not prefer high intensity physical activity or could fail to persistent severe exercise. In the study examined the relationship between exercise motivation and frequency, intensity, and duration of exercise (Duncan, Hall, Wilson, & Jenny, 2010),[24] exercise intensity was not predicted by any of motivational factors among healthy male participants regularly exercising. This finding implies that participation or adherence in high intensity exercise are not sufficiently explained by exercise motivation.

Trait self-control and motivation are correlated to each other in terms of that these are important factors inducing adherence to certain activities (Briki, 2016). High trait self-control helps people pursue clear goals by focusing on relevant and important goals for the self (Carver & Scheier, 2000), and this goal selection process is associated with the degree of self-determined motivation. According to Deci and Ryan (Ryan & Deci, 2000), one`s motivation might differ in the degree to which the activities are self-determined, and the high degree of self-determined motivation is induced by the integration of the activities and one`s sense of self. Thus, it would be considered that trait self-control and self-determined motivation might influence high intensity exercise behaviours in a similar way that restraining goal-disruptive impulses and selecting goal-related strategies.

To sum up, many people understand the efficiency of high intensity exercise, but they tend to avoid doing it because it is very stressful. It would be advantageous for public health to find what factors facilitate engagement in high intensity physical activity, and self-control and motivation would be the important psychological factors according to the findings from existing studies. Some studies insist that self-determined motivation is the key factor to explain exercise behaviours in high intensity, but others claim that it is insufficient because even highly motivated people tend to fail to participate regularly in high intensity exercise. Therefore, present study tried to examine how variations in intensity during an exercise is associated with trait self-control after controlling the impact of self-determined motivation of healthy adults who regularly participate in physical activity. The implications of this study would be helpful for understanding the participation behaviour in high-intensity exercise.

MATERIAL AND METHODS

Participants

A total 81 adults (Men: 55, Women:26) who reported exercising regularly and living in Seoul, Korea were participated in this study (Mage = 23.06, SD = 3.16). Participants were informed of the purpose and procedures of our study and expressed willingness to participate before the exercise and survey.

Measures

The following measures were used to validate the correlation between self-control and exercise intensity during the multistage 20 m shuttle run test (MST).

Self-determined motivation for aerobic exercises

We used the Korean Version of the Behavioural Regulation in Exercise Questionnaire-2 (BREQ-2) adapted by Kim and colleagues (Kim, Yang, & Lee, 2007; Wilson & Rodgers, 2004). to measure the self-determined motivation for aerobic exercises. The BREQ-2 contains 19 items in five subscales: intrinsic regulation (4 items), identified regulation (4 items), introjected regulation (3 items), external regulation (4 items), and amotivation (4 items). All items are rated on a five-point scale anchored from 0 (strongly disagree) to 4 (strongly agree). The relative autonomy index (RAI) was calculated using the above scale to measure the degree of the participants' self-determined motivation for aerobic exercises (Markland, 2011). The RAI was obtained by applying weighting to each variable according to the degree of self-determination: [(amotivation×-3) + (external regulation×-2) + (introjected regulation×-1) + (identified regulation×2) + (internal regulation×3)]. Higher RAI scores are interpreted as an indication of a higher degree of self-determined motivation. The confirmatory factor analysis confirmed the validity of the present model within our sample, χ^2 (142) = 285.396, $p < .001$, CFI = .935, TLI = .942, and RMSEA = .067, and the internal consistency of each variable was .83–.87.

Self-control

The present study used the Self-Control Scale (SCS) developed by Tangney and colleagues (Tangney et al., 2004). to measure the participants' self-control. The original SCS consists of 36 questions on five subscales (e.g., overall capacity for moderation and self-discipline, deliberate/non-impulsive action, healthy habits, work ethic, and reliability), and were rated using a five-point scale anchored from 1 (*not at all like me*) to 5 (*very much like me*). Based on the study conducted by Korean (Cho & Kwon, 2011), we used the short version of the SCS with 26 items on 3 subscales (healthy habits and reliability, moderation and self-discipline, and non-impulsiveness). The confirmatory factor analysis of this instrument with our sample confirmed a reasonable level of model fit, χ^2 (296) = 426.645, $p < .001$, CFI = .937, TLI = .928, and RMSEA = .061. The internal consistency of each subscale ranged from .80 to .84.

Calculation of mean and maximal heart rate

We calculated age-predicted maximal heart rate (HRmax) by subtracting each participant's age from 220 (Pescatello, Riebe, & Thompson, 2014; Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991). The heart rate was constantly tracked during the exercise using an electronic device (Polar Team 2), through which the percent mean heart rate (%HRmean) and the percent maximal heart rate (%HRmax) were calculated. %HRmean was calculated by (mean heart rate [HRmean] during exercise / age-predicted HRmax * 100) and %HRmax by (HRmax during exercise / age-predicted HRmax * 100).

High-intensity exercise volume

The ACSM (Pescatello et al., 2014) defines high-intensity aerobic exercises for healthy adults as the exertion at 85% of maximal oxygen uptake (VO_2max), 80% of HRmax, or above, and defines the threshold for extreme fatigue at 80% of HRmax. Based on the participants' data stored in the Polar Team2 software, we measured the duration each participant continued the MST at 80% of HRmax or above.

Measurement of the rating of perceived exertion (RPE)

The scale developed by Borg (Borg, 1982) was used to measure the participants' RPE. The instrument includes subjective ratings to the changing personal feelings and physiological reactions during a period of exercise. To determine exercise intensity, respondents were asked to indicate how hard the exercise was on a 15-point numerical scale from 6 to 20. Unlike the previous self-report measures on the survey, participants completed the RPE immediately following the termination of the MST.

Procedure

Prior to the start of the exercise, participant completed a survey that included self-control and the background variables including age-predicted maximal heart rate (HRmax) for each participant. The high intensity exercise was conducted through a Multistage 20 m Shuttle run Test (MST). This test was measured by playing the audio material with pre-recorded a sound signal where, starting from the brisk walk on the 20 m course at 8.5 km/h, the signal interval became gradually shorter by 0.5 km/h every minute. Participants began the test at a sound signal and ran back and forth on the 20 m course, as the rhythm speed of sound signal continued to increase. Participants terminated the MST when they felt, based on their own judgment, they could no longer keep up with the sound signals. All participants completed the MST in an indoor gymnasium under the same environmental condition (12–16˚C, relative humidity at 60% or below). The Polar Team2 wearable devices were attached on the participants during the MST, through which the heart rate was continually tracked. Finally, the RPE scores when they elected to terminate the MST were measured.

Analysis

Data in the present study were analysed using the AMOS 18.0 and SPSS 22.0 software. The confirmatory factor analysis was conducted to validate the construct validity of the questionnaire in sample, followed by the reliability analysis (Cronbach's α) of each measure. Next, we calculated the descriptive statistics and correlation analyses to identify the overall tendency and characteristics of the collected data. Finally, a hierarchical linear regression analysis was performed to examine the relationship between self-control, self-determined motivation, and exercise intensity (%HRmean, %HRmax, RPE upon termination of the MST, and the duration of exercise at 80% of HRmax or above). The statistical significance level (α) was set at .05 in the present study.

Ethical considerations

The research was conducted in accordance with the principles in the Declaration of Helsinki and all process was approved by Institutional Review Board at Seoul National University (IRB No. 1802/001-002). All participants provided written informed consent prior the data collection.

RESULTS

Measured variables: elementary statistics and correlation

As can be seen in Table 1, participants reported exercising slightly more than twice a week, with each exercise session lasting between 1 and 2 hours. Participants reported that they had been exercising for approximately 22 months (range, 2 to 100).

Table 1. Descriptive statistics of measured variables.

	Mean	Standard deviation	Skewness	Kurtosis
Exercise experience (in months)	22.26	28.418	1.837	2.506
Weekly exercise frequency (times)	2.39	1.472	0.542	0.440
Average duration of exercise bout (in hours)	2.91	0.883	-0.498	-0.393
Self-determined motivation (RAI)	5.88	5.608	-0.081	-0.577
Self-control (SCS)	3.40	0.417	-0.190	-0.150
%HRmean	79.14	5.089	-0.638	1.332
%HRmax	90.30	5.245	-0.774	2.696
high-intensity exercise volume (in seconds)	204.63	119.382	-0.215	-1.093
RPE upon termination of exercise	17.89	1.688	-0.732	-0.240

Table 2. Pearson's correlation between measured variables.

	1	2	3	4	5	6	7	8	9
1. Exercise experience	-								
2. Weekly exercise frequency	.37**	-							
3. Average duration of exercise bout	.27*	.41**	-						
4. Self-determined motivation (RAI)	.083	.154	.076	-					
5. Self-control	.28*	.08	.07	.10	-				
6. %HRmean	.03	-.08	-.06	.31**	.31**	-			
7. %HRmax	.19	.00	-.03	.34**	.41**	.77**	-		
8. high-intensity exercise volume	.18	.03	.17	.34**	.46**	.70**	.79**	-	
9. RPE upon termination of exercise	.04	-.02	.04	.11	.36**	.34**	.46**	.35**	-

Note. $^{*}p < .05$, $^{**}p < .01$.

The correlations between the measured variables are presented in Table 2. Self-control on the SCS was found to have a significant positive correlation with the exercise experience, %HRmean, %HRmax, high-intensity exercise, and the RPE upon termination of the exercise. The self-determined motivation for aerobic exercises was also found to have a significant positive correlation with %HRmean, %HRmax, and high-intensity exercise volume. The four variables that measure individuals' exercise intensity (%HRmean, %HRmax, high-intensity exercise volume, and RPE upon termination of the exercise) were found to be significantly correlated with one another (r's ranging from .34 - .79). Apart from these results, we also identified a significant correlation between the exercise experience and weekly exercise frequency, exercise experience and average duration of exercise bout.

Regression analysis predicting exercise intensity from self-control and motivation

Hierarchical regression analysis was conducted with four dependent variables representing exercise intensity and two predicting variables including self-control and self-determined motivation. We examined the tolerance test statistic of all hierarchical regression models to identify multicollinearity. No issues of multicollinearity were found, as the tolerance value were all 0.1 or greater. The Durbin-Watson value (1.918–2.462) was close to the threshold value of 2 and relatively distant from 0 or 4, ruling out the possibility of autocorrelation. Thus, the regression model in this study satisfies the independence requirements. Based on previous research that the degree of self-determined motivation for exercise participation is significantly correlated with participation in high-intensity exercises self-determined motivation for aerobic exercises was entered in the first step as a controlling variable to examine the predicting ability of self-control in second step. The result of the regression analysis is presented in Table 3.

Table 3. Hierarchical regression analysis summary for self-control predicting exercise intensity after controlling for self-determined motivation.

Independent Variables	*β*	*B* (SE *B*)	*F*	Δ*F*	R^2	ΔR^2	Tolerance	D.W
Dependent Variable = %HRmean								
Step 1					.097			
RAI	.311**	0.282 (0.097)	8.443**				1.000	
Step 2				7.405**	.175	.078		2.462
RAI	.283**	0.256 (0.094)	8.266***				.990	
Self-control	.281**	3.431 (1.261)					.990	
Dependent Variable = %HRmax								
Step 1								
RAI	.337**	0.315 (0.099)	10.131**		.114		1.000	
Step 2				14.670***		.140		2.166
RAI	.300**	0.280 (0.092)	13.277***		.254		.990	
Self-control	.376***	4.733 (1.236)					.990	
Dependent Variable = high-intensity exercise volume								
Step 1								
RAI	.340**	7.229 (2.253)	10.298**		.115		1.000	
Step 2				20.574***		.185		2.179
RAI	.296**	6.310 (2.027)	16.712***		.300		.990	
Self-control	.432***	123.574 (27.244)					.990	
Dependent Variable = RPE upon termination of exercise								
Step 1								
RAI	.110	0.033 (0.034)	0.970		.012		1.000	
Step 2				11.327**		.125		1.918
RAI	.075	0.022 (0.032)	6.212**		.137		.990	
Self-control	.356***	1.439 (0.428)					.990	

Note. *$p < .05$, ** $p < .01$, *** $p < .001$.

All models were statistically significant except the first step in the last regression model predicting RPE upon termination of the exercise. In other three model, %HRmean (ΔR^2 = .078), %HRmax (ΔR^2 = .140), and high-intensity exercise volume (ΔR^2 =.185) were more strongly predicted in second step with self-control than each first step.

Specifically, self-control and RAI were found to explain 17.5% of the %HRmean variance and positively predict it, and RAI (β = .283, p < .01) and self-control (β = .281, p < .01) were found to have a similar level of prediction. Self-control and RAI were found to explain 25.4% of the variance of %HRmax, and the self-control (β = .376, p < .001) had a larger than RAI (β = .300, p < .01). Self-control (β = .432, p < .001) and RAI (β = .296, p < .01) were positively predicted high-intensity exercise volume and these two variables explained 30.0% of the variance of the variable. In the regression model predicting RPE upon termination of the exercise, RAI (β = .110, p = .328) was found to explain 1.2% of the variance of RPE but it was not significant, but it was positively predicted in the second step with self-control (β = .356, p < .001).

DISCUSSION

High-intensity exercise is receiving increasing attention in recent years as a possible time-efficient exercise strategy. It brings ample health benefits with less time spent on exercising.[2] However, many people tend to avoid participating in severe intensity exercise due to excessive physical and psychological stress induced during the activity, which implies the importance of understanding how to overcome such stress in order to promote the engagement in the effective intensity of exercise. With existing findings that psychological and cognitive factors such as willpower and motivation are correlated with exercise participation in high intensity, we assumed that self-control, defined as the ability to suppress impulses and resist, could predict high intensity exercise behaviours. Thus, present study attempted to examine the impact of the self-control as a psychological factor on the tolerance of high-intensity exercise using hierarchical leaner regression analysis after controlling self-determined motivation that is known as the important factor influencing exercise participation.

Firstly, results of this study confirmed that the self-control has a significant positive correlation with several variables that measure exercise intensity including %HRmean, %HRmax, high-intensity exercise volume, and RPE upon termination of the MST, which implies that self-control would be a predictor of high-intensity exercise participation. We also confirmed from the results that there was a significant positive correlation of the self-determined motivation for aerobic exercises (RAI) with %HRmean, %HRmax, and high-intensity exercise volume. Thus, we performed hierarchical linear regression analysis to more clearly examine that self-control positively predict these dependent variables after controlling self-determined motivation. It is in line with the existing studies reported that psychological fatigue diminished physical performance in time to exhaustion exercise tasks (Brownsberger, Edwards, Crowther, & Cottrell, 2013; Marcora, Staiano, & Manning, 2009).

The result of hierarchical regression analyses showed that self-control into the model, after self-determined motivation, increased the proportion of variance explained by the model. Moreover, while there was no significant correlation between RPE upon termination of the exercise and the degree of self-determined motivation, self-control had a significant explanatory power. It implies that strong self-control ability can help to endure high intensity exercise, which in line with those individuals with more self-control can sustain certain behaviours for a longer time when faced with a stressful situation (Baumeister & Heatherton, 1996; Lewinsohn & Mano, 1993). With the existing studies reported that psychological fatigue diminished physical performance in time to exhaustion exercise tasks (Brownsberger et al., 2013; Marcora et al., 2009), our results suggest that self-control can allow individuals to perform exercises more intensely though helping them overcome the temptation to stop exercising even under physical stress. Also, our result supports that RPE can be influenced not only by the physiological changes during exercise but also by psychological factors (Borg, 1982; Rejeski, 1985).

It is also notable that the influence of self-control on %HRmax and high-intensity exercise volume was found to be relatively larger than that of the control variable (i.e., RAI). According to the new perspective of self-control, self-control is not a matter of managing a limited energy supply, it depends more on subjective beliefs and motivations (Vohs, Baumeister, & Schmeichel, 2012). However, this result suggests that self-control is more crucial variable that allows exercise participants to maintain engagement with high-intensity aerobic exercises as they develop intrinsic motivation for them. Increasing the intensity and duration of exercise requires one to build their capacity to keep themselves under control even in an extremely stressful situation. To apply these findings to Baumeister et al.'s strength model of self-control (Baumeister et al., 2006), a higher heart beat results in both physical and mental strain and depletes the self-control in exercise participants. It can thus be presumed that participants with more self-control are able to continue to exercise at a relatively higher intensity for a longer time.

Extant literature reported that self-control may have a positive influence on enhancing academic performance (Tangney et al., 2004), overcoming alcohol dependence (Lindgren, Neighbors, Westgate, & Salemink, 2014), and reducing substance abuse (Tang, Posner, Rothbart, & Volkow, 2015). Researchers also established that people with low self-control may be especially vulnerable to situational temptations that require impulse control, such as dieting (Vohs & Heatherton, 2000) and that self-control is a crucial variable in controlling binge-eating behaviour (Annesi & Gorjala, 2010). Together this data suggests that people with more self-control can better suppress impulsive behaviour when encountered with stress situations. We extended the field of research in the present study by identifying the above-mentioned effects of self-control to exercise behaviour and presented statistical evidence of an association between self-control and exercise behaviour.

Based on the limitations and shortcomings that we encountered when conducting our current study, we have several recommendations for future research. First, we call for further exploration of the association between self-control and exercise behaviour in diverse samples. The present study administered the MST in a sample of physically healthy, younger adults who exercise frequently to facilitate the procedures given the physical intensity of the MST. Research with less physically active samples will be meaningful in understanding the prevalence of insufficient physical activity in modern-day society. In addition, a more diverse sample will ensure generalizability of the findings since socio-demographic variables may affect self-control.

Next, we anticipate in future research a more in-depth analysis of the relationship between self-control and a wide range of variables that may influence participation in high-intensity exercises. Exercise participation and adherence are the product of the interaction between multiple socio-psychological variables rather than a single psychological factor. We look forward to future studies developing a new paradigm to promoting participation in and adherence to high-intensity exercises. This can be accomplished by building upon our findings that self-control has a large impact on exercise intensity and validating its relationship to other psychological variables.

Finally, we call for studies that explore means for enhancing self-control. Despite its unique characteristics of repeated depletion and replenishment, self-control can be enhanced through training and study (Muraven, Tice, & Baumeister, 1998; Oaten & Cheng, 2006). We therefore propose an experimental study that reverses the original hypotheses of our research by examining to what extent self-regulation and impulse can be altered through the regular participation in high intensity exercises and can subsequently improve self-control.

CONCLUSIONS

We establish in the present study that self-control can increase HRmean, HRmax, the duration of high-intensity exercises, and individuals' subjective perception of exercise intensity during exercise participation. Trait self-control is therefore a necessary psychological variable to account for when studying the recent trend in efficient exercise strategies. High-intensity exercises involve extreme physical and psychological stress if one participates in such exercises but cannot resist the intrinsic temptation to quit, they will not be able to achieve their exercise goals. Resisting spontaneous temptation and keeping the self under control to sustain exercise behaviour will improve the quality of the exercise regimen among modern-day people.

AUTHOR CONTRIBUTIONS

Jihoon Ahn and Inwoo Kim contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript. Sungho Kwon supervised the project and contributed to the final version of the manuscript.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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