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Original Research Article

Physical fitness and body fatness are associated with mental health in Korean young adults: a cross sectional study

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ABSTRACT

Background: It has been recognized that body fatness and mental disorders have association, however very limited evidence have proved that physical fitness and mental health have association. Relationship between physical fitness and mental health in young adults has not been fully proved. The purpose of the study was to investigate the association between physical fitness, body fatness, and mental health in young adults.
Methods: A total of 149 (97 males and 52 females) college students were included. Physical fitness (sit-ups, push-ups, 1 mile run/walk), and body mass index (BMI) was measured, and psychological questionnaires including life satisfaction, self-efficacy, the beck depression inventory (BDI), and adult self report (ASR) were administered. The levels of physical fitness and BMI were classified into tertile groups and were analyzed.
Results: Female participants with the highest tertile of BMI had highest ASR score ($p<0.05$). Participants with highest level of physical fitness showed higher level of self-efficacy in both males and females ($p<0.05$). In both male and female, physical fitness was a significant predictor for self-efficacy (Male: $\beta=0.35$, $p<0.05$, Female: $\beta=0.31$, $p<0.05$).
Conclusions: In conclusion, physical fitness and body fatness were associated with mental health. Especially, physical fitness, independent of BMI, was proved as significant indicator for mental health in young adults.

Keywords: Physical fitness, Body mass index, Mental health, Depression, Self-efficacy

INTRODUCTION

The incidence suicide in young adults has been increased rapidly in South Korea, and physical inactivity and being obese are the causes of depression and anxiety.[1,2] Levels of physical fitness, which may reflect the amount of physical activity participation, have decreased, and levels of body fatness have dramatically increased in young adults from 2007 to 2011 in South Korea.[3,4] Furthermore, it has been recognized that lower level of physical fitness and being overweight are also significantly associated with mental health in negative way.[5-9] This fact suggests the importance of increase a level of physical activity and physical fitness in that it might be a positive influence on

maintaining healthy body weight and good quality of mental health.

It have proved that being overweight and obese are associated with lower level of self-efficacy and mood disorders, such as depression and anxiety.[8-10] Becker and colleagues investigated that obese women with body mass index (BMI) ≥30 kg/m² were at higher risk for an anxiety disorder, compared to women less than 30 kg/m² (Odds Ratio (OR): 2.59, 95% CI: 1.26-5.34).[8] Furthermore, Scott and colleagues reported by their international data that being obese increases the risk of mental disorders, such as depressive symptoms and anxiety in females from 13 countries. Therefore, we could find notable link between body fatness and mental health condition.[9]

Although a number of studies have found evidences that beneficial effects of physical activity on mental health, relatively few studies have examined the relationship between physical fitness and mental health.[11,12] Boettger et al found that a lower level of cardiorespiratory fitness, assessed by the maximal oxygen uptake test, was associated with severe depressive symptoms in patients with depression.[5] Furthermore, Garber et al demonstrated that a lower level of physical function, measured by the timed up and go test, was also associated with depressive symptoms in older adults.[6,13] These studies support a fact that physical fitness and corporal functions might be related to psychological wellness. However, participants of these studies were conducted with patients with psychological problems or they were older adult population.

Very limited evidence is existing which focuses on the relationship between a level of physical fitness and mental health in healthy young adults. Furthermore, the combined impacts of physical fitness and body fatness on psychological well-being have not yet been fully recognized in young adults. Thus, the purpose of this study was to investigate the association between physical fitness, body fatness, and mental health among young adults in South Korea. We hypothesized that physical fitness would have positive association with mental health; on the other hand, body fatness would be negatively associated with mental health in this study population.

METHODS

Ethical approval

All research process was informed to all participants and they completed the written informed consent before their voluntary participation. This study was approved by the institutional review boards (IRB) at the Yonsei University College of Medicine, Shinchon Severance Hospital and all participants provided written informed consent prior to participation in the study.

Design and procedures

In this cross sectional study, all participants were college student in the identical campus, and also they were participated in one physical activity classes during a semester. All of the data were managed and collected by researchers and instructors in each class. All the assessments including physical fitness testing, mental health questionnaire and anthropometric measures were administered by trained exercise physiologists, research assistants in the psychology department. The first orientation meetings were administered at the beginning of the semester. Before the anthropometric measures and physical fitness tests, the participants completed the mental health questionnaire in 20 minutes with support of the research assistants. Under supervised condition, all physical fitness tests were conducted at the fitness training center and outdoor track of college campus.

Participants

Initially, a total of 157 participants (102 male and 55 female) in the same local college were recruited. All participants had no medical history in terms of physical and psychological problems. The participants attended in the one of physical activity classes (e.g., physical training, basketball, table tennis, a squash, dancing class) in a college. Finally, study data was obtained from a total of 149 participants (97 male and 52 female), and eight participants were excluded due to absence from the physical fitness testing.

Physical fitness measures

Physical fitness was represented by using tests including sit-up, push-up, and one mile run/walk test. The sequence of the tests was: sit-up → push-up → one mile run/walk with enough resting time between each test. Sit-up and push-up tests were conducted to measure muscular strength and endurance.[14] Sit-up and push-up test were conducted at the indoor fitness center of university campus. The sit-up test was conducted on a flat floor with a comfortable mat during 1 minute, and it was counted as one repetition when the participants touched their elbows on the floor and their knee continuously. The push-up test of male was on a flat floor, and that of female was conducted with placing their knees on the floor. One successful repetition of push-up was counted when their arms were folding at 90 degree angle and returned to completely unfolding posture. In addition, to determine cardiopulmonary fitness level, one-mile run/walk test, which is the indirect measures to estimate maximal oxygen consumption (VO2max) level, was conducted.[15] The test was performed at the 400-m track field placed in outdoor playing field of university campus. All participants were encouraged to run or walk as quickly as possible. Their performance was measured by stopwatch and it was recorded to the minute and second. The process of all physical fitness tests was informed to the

all participants, and the each test was conducted by the identical assessors.

Body composition measures

Body weight (kg), percent of body fat (%), and lean body mass (kg) were measured by bio-impedance analyzer (Inbody IHU070R, Biospace, Seoul, South Korea). Height (cm) was measured by electric extensometer (JENIX DS-102, Seoul, South Korea). BMI (kg/m²) was calculated by dividing weight by square of height (m) measurement. Waist circumference (cm) was measured at narrowest point between the iliac crests and the rib cage by a tapeline. For test and re-test reliability (internal consistency), each same assessor for each measures was allocated.

Mental health measures

A set of psychological questionnaires including life satisfaction, self-efficacy (general and social self-efficacy), the Korean version of adult self-report (ASR), and the beck depression inventory (BDI) were administered to assess overall mental health condition of participants, and all questionnaires were employed as versions translated in Korean.[16-19] The revised Korean version of life satisfaction (Cronbach's α =0.84) and self-efficacy (Cronbach's α =.86 in general self-efficacy, 0.71 in social self-efficacy) questions in the questionnaire, which was validated and the reliability was tested in the college student population, were used.[20,21] The Korean version of ASR (Cronbach's α =0.53-0.96) and BDI (Cronbach's α=0.81) scales were validated, and the reliability of the questionnaires was investigated.[22,23] Paper-pencil format of questionnaire was given to participants. Life satisfaction is composed of 5 items, and each item is scored in seven point scale (no: 1 → yes: 7; the higher number, the more likely to be satisfied with one's life). Self-efficacy score was calculated by the sum of general (internal, self-awareness relating self-efficacy) and social self-efficacy (interpersonal problems or sociality relating to self-efficacy) score.[24] The self-efficacy questionnaire contains 23 items, and each item is scored in five point scale: 1 (no), 2 (somewhat no), 3 (moderate), 4 (somewhat yes), and 5 (yes). ASR total, which represents overall problematic behaviors, is composed of eight sub-scales: anxious/depressed (fearful, worries or feel of gloom), withdrawn (tend to be alone), somatic complaints (physical self complaints), thought problems, attention problems (distraction), aggressive behavior, rule-breaking behavior, and intrusive behavior (excessive attention inducement) questions. A total of 126 items were included in ASR, each item is scored in three point scale: 0 (not true), 1 (somewhat or sometimes true) and (very or often true). The total score of ASR was calculated by sum of scores from the sub-scales.

Data analysis

Normality of all variables was tested by Shapiro-Wilk test. Gender-specific descriptive analyses for baseline characteristics including mental health variables were indicated in Table 1. BMI and physical fitness were classified into tertiles (lowest, middle, and highest group), and their mean differences were compared by using a one-way analysis of variance (ANOVA), with Scheffe's post-hoc comparison (Table 2 and Table 3). Since BMI values were not normally distributed, its values were transformed into log 10 values before association and multiple regression analyses. Furthermore, physical fitness tests (push-up, sit-up, one-mile run), were converted to z-score for standardization, because all the tests variables were not normally distributed. To investigate the best predictor from physical fitness or body fatness as independent variables (by controlling each other) for mental health as dependent variables, a multiple regression analysis was conducted. Statistical significance level was set as $p<0.05$ were considered statistically significant. All statistical analyses were performed by using SPSS software, version 18.0 (SPSS, Chicago, IL).

RESULTS

Baseline characteristics of study participants are presented in Table 1. To study the association between BMI and mental health, mental health variables were compared across the BMI tertiles (Table 2) by using one-way ANOVA. In males, there were no statistical differences in life satisfaction, general self-efficacy, BDI, and ASR total across BMI tertiles. Identical results were reported in females except for the ASR: the highest BMI tertile group showed significantly highest scores in ASR total and all sub-scales of it compared to the lowest and middle tertile groups. Only intrusive behavior showed a significantly higher score in the highest BMI tertile, when compared to the lowest one in female.

To evaluate the association between physical fitness and mental health, the mental health variables were compared across the fitness tertile groups (Table 3) by using one-way ANOVA. In males, significant differences were observed between groups according to their fitness levels in self-efficacy and somatic complaints. In females, the group with the highest level of physical fitness showed significantly higher scores across all self-efficacy variables and significantly lower depression scores compared to the group with the lowest level of physical fitness.

Multiple regression analyses was performed to assess which factor, among body fatness and physical fitness, is the most significant predictor for mental health (Table 4). In female, multiple regression analyses were performed with self-efficacy and ASR total as dependent variables. In male, the analysis was performed with self-efficacy as a dependent variable. The results showed that physical fitness was the best predictor for self-efficacy in both males ($\beta=0.35$, $p<0.05$) and females ($\beta=0.31$, $p<0.05$). BMI was a significant predictor for ASR total in females ($\beta=0.43$, $p<0.05$).

Table 1: Baseline characteristics.

	Male (n=97)	Female (n=52)
Age (years)	18.62±0.84	18.81±1.12
Height (cm)	175.19±4.42	163.65±5.41
Weight (Kg)	68.84±9.92	54.14±6.20
BMI (kg/m²)	22.42±3.04	20.22±2.15
Body fat (%)	13.64±6.16	15.45±4.38
LBM (Kg)	31.40±3.84	21.22±2.33
WC (cm)	76.53±7.85	68.23±5.25
Push-up (rep)	27.07±11.51	19.31±11.20
Sit-up (rep)	32.42±9.21	23.29±8.84
1 mile run (min)	8.57±1.70	10.40±1.22
Mental health variables		
Life satisfaction	22.75±5.47	22.14±5.16
Self-efficacy	81.07±11.68	81.10±10.91
General self-efficacy	61.22±9.22	61.00±8.65
Social self-efficacy	19.86±3.75	20.09±3.81
Bdi	25.87±5.66	26.98±7.48
ASR total	111.38±65.53	112.09±59.89
Anxious/depressed	17.44±10.57	18.49±9.57
Withdrawn	8.78±5.79	8.39±5.59
Somatic complaints	9.19±6.36	10.39±6.23
Thought problems	7.89±5.06	8.18±4.68
Attention problems	16.18±9.15	16.21±8.70
Aggressive behavior	13.52±8.62	14.27±7.90
Rule-breaking behavior	11.21±7.41	10.29±7.15
Intrusive behavior	6.61±4.10	5.51±3.24

Data are presented as means±SD; Abbreviations: BMI Body Mass Index, LBM Lean Body Mass, WC Waist Circumference; BDI Beck Depression Inventory, ASR Adult self-report.

Table 2: Anthropometrics and mental health parameters according to BMI.

	Male			P value	Female			P value
	BMI <21.0 (n=31)	**21.0≤ BM I <23.4 (n=33)**	**23.4≤ BMI (n=33)**		**BMI <19.3 (n = 17)**	**19.3≤ BMI <20.6 (n=17)**	**20.6≤ BMI (n=18)**	
Age (years)	18.37±0.85	18.87±0.86	18.66±0.75	0.065	18.76±0.90	19.06±1.60	18.61±0.70	0.468
Height (cm)	174.90±3.20	175.23±5.18	175.29±4.33	0.931	165.65±5.60	161.88±4.74	163.44±5.47	0.158
Weight (Kg)	59.35±4.45	67.56±3.85*	79.11±8.49*#	0.000	50.21±3.80	51.99±3.53	59.88±5.91*#	0.000
BMI (kg/m²)	19.41±1.49	21.99±0.61*	25.73±2.37*#	0.000	18.29±0.84	19.82±0.39*	22.42±2.01#	0.000
Body fat (%)	9.11±2.02	12.12±2.65	21.25±9.30*#	0.000	12.57±1.99	13.30±2.10	19.13±4.25*#	0.000
LBM (Kg)	28.69±1.89	31.34±3.06*	34.20±4.10*#	0.000	20.15±2.15	20.79±2.11	22.36±2.21*	0.044
WC (cm)	69.65±3.49	74.43±2.55*	85.87±5.92*#	0.000	64.23±3.27	69.20±4.11	72.75±3.56*#	0.000
Life satisfaction	22.37±5.55	23.00±5.35	22.68±5.66	0.915	22.94±6.21	22.93±4.67	19.94±3.81	0.062
Self-efficacy	79.27±12.05	80.30±11.40	83.41±11.95	0.358	80.76±10.69	85.35±10.28	77.39±10.83	0.095
General self efficacy	60.03±8.18	60.67±9.51	62.75±9.30	0.487	61.41±8.95	63.29±7.96	58.44±8.77	0.250
Social self-efficacy	19.23±3.78	19.63±3.42	20.66±4.03	0.309	19.35±3.53	22.06±3.61	18.94±3.70#	0.030
BDI	26.47±4.98	26.73±7.10	24.78±5.01	0.353	28.35±8.88	24.06±5.02	28.44±7.56	0.145
ASR total	104.77±63.61	121.63±69.05	109.35±65.03	0.593	88.00±62.28	85.94±58.45	158.11±20.43*#	0.000
Anxious/depressed	17.20±10.52	18.33±11.24	16.87±10.29	0.856	14.94±9.15	13.50±8.40	26.28±5.31*#	0.000
Withdrawn	8.27±5.66	9.70±5.94	8.61±5.76	0.607	6.65±5.98	5.63±4.69	12.50±3.28*#	0.000
Somatic complaints	8.27±5.95	10.00±6.44	9.45±6.74	0.564	8.41±6.43	7.88±6.54	14.50±3.16*#	0.001
Thought problems	7.20±4.76	8.40±5.05	8.06±5.38	0.641	6.18±4.33	6.13±4.88	11.89±1.81*#	0.000
Attention problems	15.60±9.51	17.43±9.40	15.45±8.80	0.651	12.24±9.67	13.50±8.13	22.39±3.62*#	0.000
Aggressive behavior	12.63±8.36	15.17±9.16	13.26±8.57	0.504	12.06±8.55	10.63±8.09	19.61±3.05*#	0.001
Rule-breaking behavior	10.27±6.92	12.83±8.24	10.77±7.14	0.372	7.12±7.36	7.56±7.42	15.72±1.57*#	0.000
Intrusive behavior	5.90±3.77	7.50±4.32	6.71±4.13	0.321	3.82±3.43	5.13±3.40	7.44±1.62*	0.002

Data are presented as means±SD; Post-hoc analysis: Scheffe; * significantly different with 1st tertile group (BMI <21.0 in male, BMI <19.3 in female), # significantly different with 2nd tertile group (21.0≤BMI <23.4 in male; 19.3≤ BMI <20.6 in female). * # p<0.05. Abbreviations: BMI Body Mass Index, LBM Lean Body Mass, WC Waist Circumference, BDI Beck Depression Inventory; ASR Adult Self-Report.

Table 3: Anthropometrics and mental health parameters according to physical fitness.

	Male				Female			
	1st tertile (n = 32)	2nd tertile (n = 32)	3rd tertile (n = 33)	P value	1st tertile (n = 17)	2nd tertile (n = 17)	3rd tertile (n = 18)	P value
Age (years)	18.78±0.83	18.69±0.90	18.39±0.75	0.148	18.47±0.72	18.88±0.93	19.06±1.51	0.293
Height (cm)	174.85±4.80	174.06±4.19	176.61±3.98	0.057	165.41±4.91	163.00±5.94	162.61±5.21	0.262
Weight (Kg)	71.34±10.76	67.24±10.00	67.95±8.76	0.211	55.72±7.96	53.66±5.62	53.09±4.69	0.433
BMI (kg/m²)	23.37±3.66	22.15±2.68	21.76±2.50	0.082	20.33±2.49	20.27±2.58	20.06±1.31	0.931
Body fat (%)	16.29±8.22	13.60±4.04	10.92±3.93*	0.006	16.79±4.91	15.39±4.42	14.14±3.61	0.260
LBM (Kg)	30.53±3.13	31.03±4.51	32.67±3.63	0.115	21.29±2.72	21.68±2.40	20.88±1.95	0.723
WC (cm)	77.63±9.72	76.63±7.61	75.23±5.65	0.562	68.77±5.81	69.28±4.46	67.07±5.22	0.547
Life Satisfaction	22.00±5.70	22.72±5.65	23.61±5.10	0.541	22.18±6.50	22.31±4.76	21.94±4.15	0.979
Self-Efficacy	77.31±9.78	81.34±12.60	84.45±11.69*	0.046	75.12±9.75	81.53±10.30	86.33±10.15*	0.007
General self-efficacy	58.59±8.02	61.03±9.81	63.93±9.21	0.063	57.24±7.81	61.18±7.20	64.39±9.57*	0.047
Social self-efficacy	18.72±3.62	20.31±3.59	20.52±3.87	0.108	17.88±3.79	20.35±4.01	21.94±2.51*	0.005
BDI	27.25±7.11	25.16±4.71	25.21±4.77	0.241	31.12±9.58	24.94±4.66*	25.00±5.95*	0.018
ASR total	124.19±63.86	116.19±65.75	93.75±65.15	0.157	122.88±54.74	102.75±68.16	110.22±58.55	0.628
Anxious/depressed	19.09±10.62	17.84±10.31	15.38±10.75	0.362	21.71±9.44	15.75±10.29	17.89±8.63	0.194
Withdrawn	10.41±6.14	8.84±5.33	7.09±5.57	0.071	7.41±5.65	9.65±5.34	7.50±6.51	0.518
Somatic complaints	11.03±6.80	9.63±6.06	6.91±5.66*	0.029	11.06±5.06	9.94±7.60	10.17±6.20	0.864
Thought problems	8.75±5.02	8.41±4.96	6.50±5.05	0.159	9.24±4.21	7.00±5.10	8.22±4.75	0.399
Attention problems	17.78±8.80	16.69±9.67	14.06±8.84	0.250	17.53±8.08	15.25±9.60	15.83±8.78	0.741
Aggressive behavior	15.41±8.10	14.13±8.69	11.03±8.73	0.113	15.12±7.32	13.63±9.30	14.06±7.46	0.859
Rule-breaking behavior	12.34±7.06	11.91±7.46	9.38±7.59	0.226	10.88±6.99	9.504±7.47	10.44±7.37	0.857
Intrusive behavior	6.97±3.81	7.06±4.16	5.81±4.34	0.403	5.12±2.85	5.69±3.66	5.72±3.34	0.835

Data are presented as means ± SD; Post-hoc analysis: Scheffe; 1st tertile group: least physically fit, 3rd tertile group: highest physically fit. *significantly different from1st tertile, # significantly different from 2nd tertile. * #p<0.05.Abbreviations: BMI=Body Mass Index, LBM=Lean Body Mass, WC=Waist Circumference, BDI=Beck Depression Inventory, ASR=Adult Self-Report.

Table 4: Multiple regression analysis between physical fitness, BMI, and age in self-efficacy and ASR-total indexes.

	B	SE	t	P value	β	R^2
Female self efficacy						
Age	1.34	1.29	1.03	0.306	0.14	
BMI	-50.94	32.61	-1.56	0.125	-0.21	0.18
PF*	1.46	0.64	2.30	0.026	0.31	
ASR total						
Age	-5.24	7.33	-0.72	0.478	-0.10	
BMI*	576.49	176.99	3.26	0.002	0.43	0.20
PF	3.15	3.47	0.91	0.368	0.12	
Male self-efficacy						
Age	1.17	1.38	0.85	0.396	0.08	
BMI	39.83	20.33	1.96	0.053	0.20	0.12
PF*	1.78	0.52	3.43	0.001	0.35	

*p<0.05; In women, the ASR Total scores showed significant difference between the groups which was divided by BMI range, and the Self-Efficacy scores showed significant difference between the groups which was divided by PF range. Therefore, the Self-Efficacy and ASR Total were further analyzed through the multiple regression analysis. Likewise, in men, the Self-Efficacy scores showed significant difference between the groups which was divided by PF range.
Abbreviations: BMI=Body mass index, PF=Physical Fitness, ASR=Adult Self-Report, B=Unstandardized coefficient, SE=Standard Error, β=Standardized; Coefficient.

DISCUSSION

We examined the association between physical fitness, body fatness and mental health in college students. The results indicated that levels of physical fitness were associated with self-efficacy in both male and female students, and levels of body fatness were associated with all sub-scales of the ASR in females. Additionally, our multiple regression analyses showed that physical fitness, not age and BMI, was a significant predictor for self-efficacy in both males and female. Only few studies have examined the association between cardiorespiratory fitness or physical function, and mental health.[5-7] Our study is the first study to investigate associations between physical fitness, body fatness and mental health in college students by using the sit-up, push-up, and one-

mile run tests as measurements of physical fitness. Furthermore, we used a set of mental health questionnaire, which includes assessments of depressive symptoms, anxiety and problematic behaviors, aiming to assess overall mental health conditions.

In females, body fatness was significantly associated with self-efficacy and ASR, which assesses problematic behaviors using a self-reporting survey.[18] This result may indicate that females are more likely concerned about their physical appearance than males, and it can cause negative effect on their mental health. In particular, obese females are sensitive about their body image and they generally have lower satisfaction or self-esteem level.[25] We examined ASR items, which contain variety of feelings, including anxiety or depression, being withdrawn, having somatic complaints, thought problems, attention problems, aggressive behaviors, rule-breaking behavior and intrusive behavior. These ASR scores showed a significant association with the highest BMI group in females. These findings were consistent with previous findings from other studies.[8,9,26] Becker and colleagues reported that a higher level of BMI negatively associated with anxiety in young females ages 18 – 25 years.[8] Furthermore, Scott et al examined that a significant association between BMI and mental health outcomes (comprised of anxiety and depressive symptoms) was found in large number of females (n=62,277) ages 18 years and above from 13 countries.[9] Although ASR questionnaire was not used in the previous literatures, results with anxiety and depressive symptoms correspond with our finding. In accordance with our study results, Anderson et al reported that obese female adolescents showed a higher risk of anxiety (Hazard Ratio (HR): 3.8, 95% CI: 1.3-11.3) than that of normal weight adolescents.[26] Consistent with this finding, no significant relationship between BMI and anxiety was discovered in our male participants. We may suggest that body fatness is not an influential factor on mental health in males, when compared to females. However, further epidemiological and experimental studies with larger samples examining an association between body fatness and mental disorders with gender specific analyses are needed to demonstrate the fact. Contrary to findings from previous studies reported that body fatness and depression have a significant association in females; however, we did not observe that association.[9,26] The rationale behind this discrepancy might be explained by the fact that low BMI range in female participants in our study. The average of BMI was 22.42 kg/m² in the highest BMI group (upper tertile), which lies in normal weight range (BMI criteria in Asia, 23.0–24.9 kg/m²: overweight, 25.0 kg/m² ≤ obese).[27]

We proved that physical fitness was significantly associated with self-efficacy. Both male and female college students, who are physically fit than others, were more likely to have higher self-efficacy. This finding may be explained by a theoretical study from Bandura et al, which defines self-efficacy as a concept that is related to self-confidence and achievement of some activities in daily life.[17] The physical fitness in the concept was defined as an ability to perform certain physical skills, and self-efficacy was defined as a sense of confidence, and our results indicate a positive association between physical fitness and self-efficacy.[17,28] In addition, some previous studies have also investigated that physical activity and exercise participation were closely related with improvement of self-efficacy.[29,30] We may connect this fact by evidence to our finding that physical activity directly improves physical fitness.

Interestingly, a level of physical fitness was also associated with depression in females. Compared to the least fit group, the moderately fit and the fittest group showed a lower BDI score, which suggests physical fitness would have a positive relationship with mood and depressive symptoms. This finding from our study is in agreement with previous studies, which report a negative association between depressive symptoms and physical fitness.[5-7] According to the previous studies, a lower level of physical function, measured by time up and go test, was associated with a high level of depression in older adults, and increased physical fitness through regular exercising was negatively associated with depression in patients with depressive disorders.[5,6,13] Likewise, a large population (n=5497) in a cohort study proved significant associations between muscular strength and endurance, and depressive symptoms.[7] Although only females showed a significant negative association between a level of physical fitness and depressive symptoms, prior studies and our study found a negative association trend between depression and physical fitness. There were no significant differences of BMI or body weight between the least fit and the fittest group; however, we demonstrated that the least fit group showed significantly lower level of depressive symptoms in females. Therefore we can identify an association between depressive symptoms and physical fitness itself, especially in female college students. Furthermore, our study is the first to examine the association between physical fitness and depression in university students. We can suggest that improving one's level of physical fitness can be a behavioral medicine for prevention of depression.

Likewise other literatures, our study has several limitations. The relatively small number of participant and unbalanced gender ratio may undermine the generalizability of the findings, indicating that future research efforts should include a larger number of participants with a balanced gender ratio. Additionally, the levels of BMI of participants were relatively low, with narrow BMI range. We could investigate only the relative comparison within the study participants. Due to a skewed distribution of BMI in our participants, we analyzed body fatness based on BMI tertiles. Future studies should include a diverse set of wider range of ages, BMI, or a broader social stratum, which would have greater support for an external validity.

CONCLUSION

This cross sectional study showed that BMI was closely related to mental health only in females and physical fitness, independent of body fatness, was proved as significant predictor for self-efficacy in both males and females. Therefore, we may suggest that physical fitness may be an important factor for maintaining a healthy mental condition in young adults. Since our study is a cross sectional study with relatively small number of participants, further prospective study with intervention is needed to investigate a causal relationship between physical fitness, body fatness, and mental health in young adult population.

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