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Original Article

Weight Control in Postmenopausal Korean Patients with Osteoarthritis

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Abstract

Background: Weight control is crucial for osteoarthritis management. This study investigated weight control methods in postmenopausal Korean osteoarthritis patients and examined their correlation with subjective health status and figure recognition, obesity, quality of life (QoL), and hemodynamic variables.

Methods: One thousand six hundred and seventy-eight female postmenopausal osteoarthritis patients participated in the 2018 Korea National Health and Nutrition Examination Survey. A frequency analysis was conducted for weight control methods, and phi coefficients for crossover analyses or Cramer's V coefficient were calculated to identify the relationships between weight-control-related variables and subjective health status and QoL. Using independent *t*-tests, we examined the relationships of weight control methods with hemodynamic variables.

Results: Postmenopausal osteoarthritis patients' preferred weight control methods were exercise, meal volume reduction, functional diet consumption, and the skipping of meals. Osteoarthritis patients who performed exercise demonstrated improved subjective figure recognition and health status, body weight, and recent 2-week discomfort, QoL, and hemodynamic variables (systolic blood pressure and fasting glucose, hemoglobin A1C, total cholesterol, high-density lipoprotein cholesterol, and high-sensitivity C-reactive protein [hs-CRP] levels). However, patients who attempted weight control by food volume reduction made relatively harder efforts to lose weight but were more likely to view themselves as obese, and demonstrated higher pain levels, anxiety/depression, and recent 2-week discomfort. Further, they exhibited lower triglyceride levels, as did patients who skipped meals.

Conclusion: Overall, Korean postmenopausal osteoarthritis patients' preferred weight control methods were exercise and reduced food intake. Although reduced food intake was effective for weight control, exercise improved mental health and hemodynamics, particularly inflammation (hs-CRP) levels.

Keywords: Exercise; Body mass index; Subjective figure recognition

Introduction

Degenerative arthritis involves deterioration of cartilage and bones surrounding a joint. Osteoarthritis prevalence in the elderly Korean population (aged ≥65 yr) is 37.7%, and the disease is approximately three times more common in women (50.1%) than in men (20.2%) (1). The prevalence is higher in postmenopausal women in their 60s (20.8%) and 70s (36.1%) than in those in their 50s (7.2%) (2). Decreased activity levels from various physical and mental changes in postmenopausal women result in musculoskeletal function loss, thereby aggravating various diseases and symptoms, including sarcopenia, osteoporosis, and osteoarthritis (3,4).

Osteoarthritis, a severe disease, involves a 40% activity reduction (i.e., number of restricted days of activity due to arthritis symptoms in diagnosed patients) (5). Indeed, 10%–30% of people diagnosed with arthritis experience restricted mobility, activity, and quality of life (QoL) due to considerable pain (6–8). In women, effort to increase muscle mass and decrease fat mass is necessary because menopause causes decreased muscle mass and fat accumulation (9). Obesity accelerates osteoarthritis in the lower limbs due to excessive body weight and inflammation (10). Thus, preventing obesity and decreasing its burden are important goals for managing and preventing osteoarthritis. In particular, osteoarthritis patients experience several activity restrictions from pain; weight reduction helps to manage this side effect (11–12). A 10% decrease in body weight in osteoarthritis patients yields decreased pain, improved function, improved health-related QoL, and decreased inflammation and knee joint loads than with a <10% weight loss (13).

It is important to investigate various existing weight control methods because they relate to postmenopausal osteoarthritis management. Although pain control is important for managing osteoarthritis, subjective health status and QoL (psychological aspects) should also be considered because osteoarthritis-related arthrodynia results in the restriction of function, lack of sleep, fatigue, depressed mood, and loss of independence (14).

Thus, we investigated the preferred weight control methods for Korean postmenopausal osteoarthritis patients and determined the relationships of subjective health status and figure recognition, obesity, QoL, and hemodynamic variables with weight control methods.

Materials and Methods

Study design and participants

Of 7,991 participants in the 2018 Korea National Health and Nutrition Examination Survey (KNHANES) by the Korean Center for Disease Control, this study assessed 1,678 female postmenopausal osteoarthritis patients. The participants' mean age, age at diagnosis, menopausal age, and menarcheal age were 64.9±9.1, 60.3±9.4, 49.7±4.2, and 14.5±1.9 yr, respectively. The participants' mean height, body weight, and body mass index (BMI) were 154.5±6.0 cm, 57.7±8.8 kg, and 24.1±3.3 kg/m^2, respectively.

Study items and protocol

Weight control methods

Weight control methods used by osteoarthritis patients included exercise (aerobic and resistance exercise), fasting (skipping meals for >24 h), meal reduction (reduced amount of food without skipping meals), skipping a meal (<24 h), oriental medicine consumption, functional food consumption, single-food diet (eating only one food [grapes, milk, potato, or sweet potato] per meal), and non-prescribed weight-loss pills.

Obesity, subjective health and QoL

Subjective and objective variables were measured to identify participants' obesity rate. Via interviews, subjective figure recognition was assessed on participants' thoughts about their obesity, past-year body weight changes, and past-year efforts to control body weight. The objective obesity rate was determined by measuring each participant's waist circumference (WC) and BMI. The participants were classified into four BMI groups: underweight [<18.5]; normal weight [18.5–23]; pre-obesity [23–25]; and obesity [>25 kg/m^2].

In surveys, subjective health status parameters that were closely related to osteoarthritis and recent 2-week discomfort and QoL were measured. The EuroQol-5 dimension instrument, developed by the EuroQoL Group for QoL measurement, comprises five objective items (motility, self-care, usual activities, pain/discomfort, and anxiety/depression). The equipment's Cronbach's α (reliability) in this study was 0.78.

Hemodynamic variables and blood analysis

Participants' resting heart rate and systolic (SBP) and diastolic blood pressure were measured. Double products were calculated by multiplying the resting heart rate and SBP. Participants' glucose, hemoglobin A1C (HbA1c), total cholesterol (TC), triglyceride, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), TC/HDL-C, LDL-C/HDL-C, and high-sensitivity C-reactive protein (hS-CRP) levels were analyzed from fasting blood.

Ethical approval

Institutional review board approval for this study was waived because the KNHANES had previously been approved (https://knhanes.cdc.go.kr/).

Statistical analyses

By frequency analysis, we identified the primary weight loss methods employed by osteoarthritis patients. Crossover analyses were conducted to identify the relationships between subjective and objective obesity-related variables, objective health status, and recent 2-week discomfort and QoL according to weight control methods. In the crossover analyses, phi coefficient was calculated for sub-variables on a nominal scale, and the Cramer V coefficient was calculated for three sub-variables. Missing values were excluded from data analyses. Furthermore, *t*-tests were conducted for differences in WC and hemodynamic variables according to weight control methods, and α was set at 0.05. All analyses were conducted using SPSS Statistics for Windows, version 18 (SPSS Inc., Chicago, Ill, USA).

Results

Participants weight control methods' rates are presented in Table 1 and Fig. 1.

Table 1: Participation rates of various weight-loss methods in osteoarthritis patients

Weight control methods	*% (n)*
Exercise	42.7% (773)
Fasting (>24 h)	0.5% (9)
Meal volume reduction	42.5% (699)
Skipping meals (<24 h)	4.3% (71)
Taking oriental medicine	0.9% (16)
Functional diet consumption	4.9% (80)
Single-food diet	1.5% (25)
Unprescribed weight-loss pill	0.6% (11)
Prescribed weight-loss pill	1.8% (30)

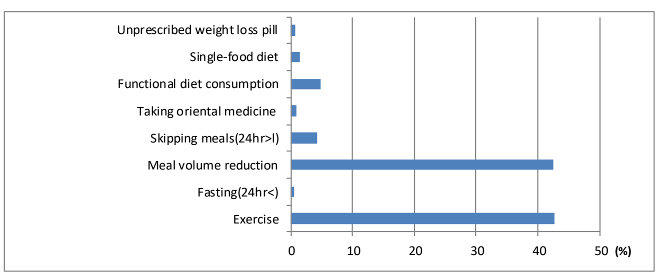

Fig. 1: Participation rates of various weight-loss methods in osteoarthritis patients

Their preferred weight control methods were exercise (42.7%), meal volume reduction (42.5%), functional diet consumption (4.9%), and skipping of meals (4.3%). Participants' subjective figure recognition, changes in body weight and weight control, obesity, and WC values are shown in Table 2.

Significant correlations existed between subjective figure recognition and participation in resistance exercise ($P<0.022$), meal reduction ($P<0.017$), functional diet consumption ($P<0.026$), and skipping of meals ($P<0.043$).

Table 2: Subjective figure recognition, changes in body weight, weight control efforts, obesity, and waist circumference according to weight control method in postmenopausal osteoarthritis patients

Variable		*Exercise*				*Meal volume reduction (n)*		*Functional diet consumption (n)*		*Skipping meals (<24 h) (n)*	
		Aerobic exercise (n)		*Resistance exercise (n)*							
		Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
Subjective figure recognition	Very very thin	22	55	3	74	5	7	1	11	1	11
	Very thin	48	98	21	125	24	7	0	31	2	29
	Normal	217	459	115	563	252	137	21	368	18	371
	Light obesity	198	397	80	517	316	126	41	401	33	409
	Heavy obesity	56	117	22	152	102	34	17	119	17	119
	Cramer V coefficient	*0.021*		*0.083**		*0.109**		*0.105**		*0.099**	
Compared with 1 year ago, has your weight changed?	No change	386	803	175	1016	488	201	46	643	43	646
	Weight loss	58	137	23	173	65	34	7	92	7	92
	Weight gain	96	182	43	237	144	76	27	193	21	199
	Cramer V coefficient	*0.027*		*0.029*		*0.061*		*0.086*		*0.054*	
Have you tried to control your weight within the year?	Weight loss effort	215	387	107	495	487	170	60	597	60	597
	Weight maintenance effort	132	194	63	265	212	141	20	333	11	342
	Weight gain effort	25	39	12	52	0	0	0	0	0	0
	No effort	170	506	59	620	0	0	0	0	0	0
	Cramer V coefficient	*0.135****		*0.135****		*-0.145****		*0.061*		*0.112****	
Obesity	Underweight	13	26	4	35	7	4	9	10	1	10
	Normal	225	383	115	494	222	109	21	244	18	313
	Pre-obesity	146	275	60	362	190	76	22	310	13	253
	Obesity	157	425	61	523	271	117	28	51	38	352
	Cramer V coefficient	*0.094**		*0.103***		*0.088*		*0.066*		*0.092*	
Waist Circumference (cm)		80.4±8.6***	82.5±9.1	80.2±8.7**	82.1±9.0	82.7±9.1*	81.4±8.3	82.6±8.9	82.2±8.8	84.7±9.2*	82.1±8.8

*: *P*<0.05, **: *P*<0.01, ***: *P*<0.001; tested by cross-analysis, waist circumference: tested using *t*- test

Positive correlations (*P*<0.001) existed among past-year efforts to control body weight, aerobic exercise, resistance exercise, and skipping a meal, while negative correlation occurred with meal reduction (*P*<0.001).

Significant correlations occurred with obesity and aerobic exercise (*P*<0.012) and resistance exercise (*P*<0.001). *t*-tests revealed significant effects of exercise (aerobic and resistance) (*P*<0.002), meal reduction (*P*<0.050), and skipping of meals (*P*<0.050) on WC. Smaller WC occurred in patients who exercised than in non-exercising participants; however, larger WC occurred in patients who reduced or skipped meals than in those who did not.

Table 3 shows the effects of the preferred weight control methods on subjective health status and 2-week discomfort and QoL.

Significant correlations occurred in subjective health status and recent 2-week discomfort with exercise (aerobic and resistance), meal reduction (*P*<0.001), and functional diet (*P*<0.022). QoL correlated significantly with aerobic exercise, motility, self-care, daily living activity, and pain/discomfort (all *P*<0.001). Resistance exercise correlated significantly with motility (*P*<0.001), self-care (*P*<0.030), usual activities (*P*<0.001), and pain/discomfort (*P*<0.001). Meal reduction correlated significantly with pain/discomfort (*P*<0.025) and anxiety or depression (*P*<0.008). Functional diet correlated significantly with motility (*P*<0.024).

Table 3: Changes in subjective health status and quality of life according to weight control method in postmenopausal osteoarthritis patients

Weight control-related variables			*Exercise*				*Meal volume reduction (n)*		*Functional diet consumption (n)*		*Skipping meals (<24 h) (n)*	
			Aerobic exercise % (n)		*Resistance exercise (n)*							
			Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
Subjective health Status		Very good	23	44	23	44	35	12	4	43	5	42
		Good	216	216	108	171	135	71	17	189	10	196
		Normal	110	747	275	579	360	16.2	42	482	32	492
		Bad	36	292	111	215	127	52	12	167	16	163
		Very bad	9	137	27	119	42	12	5	5	8	46
		Cramer V coefficient	*0.105****		*0.172****		*0.064*		*0.023*		*0.095*	
Discomfort during recent 2 weeks		Yes	148	385	50	485	213	62	13	262	25	250
		No	396	743	191	951	486	249	67	668	46	689
		phi coefficient	*.070***		*.098****		*-.109****		*.072**		*-.049*	
QoL	Motility	No difficulty walking	449	742	204	988	536	254	71	719	54	736
		Walking is a bit difficult	94	370	37	431	159	56	8	207	17	198
		Lying all day	1	1.0% (16)	0	17	4	1	1	4	0	5
		Cramer V coefficient	*0.176****		*0.125****		*0.057*		*0.086**		*0.026*	
	Self-care	No problems taking a bath/getting dressed	525	1024	236	1314	668	301	79	890	66	903
		Some problems taking a bath/getting dressed	18	95	5	109	31	10	1	40	5	36
		Unable to take a bath/get dressed without help	1	9	0	10	0	0	0	0	0	0
		Cramer V coefficient	*0.103****		*0.084***		*0.029*		*0.042*		*0.042*	
	Usual activities	No ADL disruption	493	941	223	1215	626	286	75	837	65	847
		ADL is somewhat impeded	50	177	18	210	72	25	5	92	6	91
		Unable to perform ADL	1	10	0	11	1	0	0	1	0	1
		Cramer V coefficient	*0.099****		*0.081***		*0.041*		*0.035*		*0.014*	
	Pain/ discomfort	No pain/discomfort	386	691	177	903	457	230	58	629	41	646
		Some pain/discomfort	140	372	58	456	218	72	19	271	27	263
		Severe pain/discomfort	18	65	6	77	24	9	3	30	3	30
		Cramer V coefficient	*0.098****		*0.081***		*0.085**		*0.032*		*0.061*	
	Anxiety/ depression	No anxiety/depression	470	963	217	1221	586	283	73	796	60	809
		Some anxiety/depression	69	142	24	187	104	27	6	125	10	121
		Severe anxiety/depression	5	22	0	27	3	1	1	9	1	9
		Cramer V coefficient	*0.042*		*0.064*		*0.098**		*0.048*		*0.015*	

*: $P<0.05$, **: $P<0.01$, ***: $P<0.001$; tested by cross-analysis. ADL=activities of daily living.

Table 4 shows the effects of weight control methods on hemodynamic variables. Aerobic exercise yielded significant effects on SBP ($P<0.001$) and fasting glucose ($P<0.005$), HbA1c ($P<0.033$), TC ($P<0.006$), and HDL-C ($P<0.010$) levels. Resistance exercise yielded significant effects on SBP ($P<0.001$) and fasting glucose ($P<0.003$), HbA1c ($P<0.014$), TC ($P<0.001$), HDL-C ($P<0.001$), and hs-CRP ($P<0.018$) levels. Triglyceride levels were significantly related to meal reduction ($P<0.042$) and skipping of meals ($P<0.037$).

Discussion

Osteoarthritis involves a gradual articular cartilage deterioration, resulting in inflammation and body function limitations through physical aging, obesity, joint damage, and loss of strength (15). We identified exercise, meal reduction, and functional diet as the preferred weight control methods in Korean postmenopausal osteoarthritis patients. Although reduced food intake was effective for weight control, exercise improved the mental health and hemodynamics, particularly inflammation (hs-CRP) levels.

Table 4: Hemodynamic variables and blood analysis according to weight control method in postmenopausal osteoarthritis patients **(Mean +-SE)**

Weight control-related variables	*Exercise*				*Meal volume reduction (n)*		*Functional diet consumption (n)*		*Skipping meals (<24 h) (n)*	
	Aerobic exercise (n)		*Resistance exercise (n)*							
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
Resting HR (bpm)	58.5± 10.7	59.0± 14.7	55.6± 5.3	58.5± 14.1	56.5± 9.7	59.4± 16.4	53.6± 2.58	57.7± 12.6	58.2± 7.7	57.3± 12.6
SBP (mmHg)	122.6± 17.4**	125.65± 18.2	119.4± 17.5***	125.5± 11.9	121.4± 17.2	121.9± 17.8	119.5± 15.9	121.7± 17.5	122.9± 17.2	121.4± 17.4
DBP (mmHg)	75.0± 9.5	75.01± 9.5	73.6± 9.1	74.7± 10.1	75.5± 9.5	75.5± 9.5	76.5± 9.0	75.4± 9.5	77.3± 10.7	75.3± 9.4
Double product (mmHg·bpm)	7232.1± 290.1	7600.7± 294.5	6603.6± 244.4	7639.7 ± 248.5	6836.5± 251.7	7192.1± 237.9	6307.5± 219.4	6909.1± 211.5	7028.8± 201.2	6902.7± 211.1
Fasting Glucose (mg/dL)	101.3± 18.1**	104.5± 23.8	88.6± 16.4**	104.2± 22.9	101.9± 17.7	100.6± 15.2	101.7± 13.9	101.5± 17.2	99.8± 13.3	101.6± 17.3
HbA1c(%)	5.87± 0.7*	5.96± 0.84	5.81± 0.5*	5.95± 0.8	5.88± 0.7	5.81± 0.5	5.80± 0.5	5.86± 0.6	5.74± 0.5	5.87± 0.7
TC (mg/dL)	200.3± 38.1**	194.5± 40.5	204.2± 39.1***	195.1± 39.8	198.0± 38.3	201.1± 38.2	198.2± 36.0	199.0± 38.4	198.1± 42.7	199.1± 37.9
TG (mg/dL)	122.5± 38.4	130.1± 32.5	121.8± 48.1	121.8± 35.1	119.7± 43.3*	132.7± 36.3	126.7± 48.8	123.5± 35.9	140.8± 43.9*	122.3± 32.3
LDL-C (mg/dL)	115.6± 32.8	113.8± 37.4	117.3± 39.7	114.1± 35.7	118.5± 32.9	116.6± 39.4	130.0± 16.0	116.86± 36.2	111.3± 45.1	118.8± 33.7
HDL-C (mg/dL)	53.3± 12.4**	51.6± 12.4	54.9± 11.7***	51.7± 11.7	53.5± 12.4	53.0± 12.3	53.1± 11.5	53.3± 12.5	52.7± 11.9	53.3± 12.4
TC/HDL-C ratio	3.9± 1.00	3.92± 1.06	3.86± 1.05	3.93± 1.08	3.69± 1.75	3.78± 1.04	3.73± 2.08	3.75± 1.07	3.77± 0.87	3.75± 0.48
LDL-C/HDL-C ratio	2.7± 0.87	2.77± 0.94	2.64± 0.87	2.75± 0.89	2.20± 0.74	2.15± 0.91	2.45± 0.30	2.20± 1.05	2.13± 0.51	2.22± 0.68
hs-CRP (mg/L)	1.1± 0.85	1.18± 1.01	0.86± 1.02*	1.21± 1.01	1.11± 1.20	0.94± 1.42	1.37± 0.82	1.04± 0.86	0.85± 1.03	1.08± 1.08

*: $P<0.05$, **: $P<0.01$, ***: $P<0.001$; tested by an independent *t*-test. HR=heart rate; SBP=systolic blood pressure; DBP=diastolic blood pressure; HbA1c=hemoglobin A1C; TC=total cholesterol; TG=triglycerides; LDL-C=low-density lipoprotein cholesterol; HDL-C=high-density lipoprotein cholesterol; hs=CRP=high-sensitivity C-reactive protein.

Joint pain can reflect the fundamental pathological process of osteoarthritis, and osteoarthritis risk increased by 36% for every 5 kg body weight increase (16). Thus, weight control is crucial for pain management in osteoarthritis patients. Body weight increase during menopause often results from voluntary decrease in activity levels (9). Increasing physical activity levels and controlling energy intake addressed these problems the most. The third and fourth most common weight control methods in our study were functional diet and skipping of meals, which require relatively little effort compared with exercise and meal reduction.

With subjective figure recognition, patients who performed resistance exercise, ate functional diets, and skipped meals did not think they were obese, although people who ate reduced meal volumes thought they were. It is assumed that people who exercised, ate functional foods, and skipped meals were more focused on maintaining their weight and health, while people who ate less were more focused on weight loss. Furthermore, not choosing exercise (aerobic or resistance) or meal-skipping demonstrated more effort to lose body weight. It is assumed that psychological anxiety about potential weight increase could affect their results. However, people who attempted weight loss by reducing meal volumes showed twice the effort for body weight loss. Thus, people who exercise or skip meals to control their body weight think about a wide margin body weight loss, whereas people who reduce meal volumes make significant efforts to lose body weight.

BMI, the objective indicator for weight control, was lower in participating aerobic and resistance exercise participants than in non-participating ones. WC, the indicator for visceral fat, was also lower in those who exercised than in those who did not. Additionally, WC was higher with skipping meals or eating smaller meals. This means that increasing rest and active energy expenditure (by increasing basal metabolism and strength through exercise) is more effective than reducing food intake (which saves basal metabolism and reduces lean mass) for the reduction of abdominal fat mass (17).

Osteoarthritis confers a relatively low QoL compared with other diseases and a high degree of activity restriction (5). In this study, women with osteoarthritis who participated in exercise (aerobic or resistance) for body weight control showed improved subjective health status, 2-week discomfort, and QoL (motility, self-care, usual activities, pain/discomfort, and anxiety or depression) than non-participating women. Osteoarthritis-related pain is strongly related to weight control. Physical exercise in osteoarthritis patients is advantageous because it alleviates pain and improves body function, balance, strength, and flexibility as well as weight loss (18, 19). Several exercise methods exist for improving or preventing osteoarthritis. Aerobic training (e.g., walking or cycling) improves range of motion, weight loss, and musculoskeletal pain in obese and osteoarthritis patients (20–22), and resistance exercise improves function and range of motion and decreases pain (23). Gradual weight loss achieved through these methods minimizes pain and kinesiophobia (24).

Osteoarthritis patients who reduced meal volumes made more effort to lose weight but regarded themselves as more obese and in more discomfort. Pain, discomfort, anxiety, and depression have negative psychological effects. Although weight loss is a very important factor in relieving pain, weight control through meal volume reduction requires mental fortitude because it requires continuous efforts.

In identifying hemodynamic variables according to weight control methods in this study, significant differences in SBP and fasting glucose, HbA1c, TC, and HDL-C levels occurred with aerobic exercise; further, SBP and fasting glucose, HbA1c, TC, HDL-C, and hs-CRP levels were related to resistance exercise. In this study, exercise (both aerobic and resistance) correlated with lower SBP, which is closely related to hypertension and fasting glucose and HbA1c (a possible indicator of diabetes) levels. Furthermore, exercise lowers TC levels (which are related to hypercholesteremia) and increases HDL-C levels (which removes cholesterol in blood vessels, and sends it to the liver). Thus, exercise prevents various complications that accompanies osteoarthritis.

Obesity increases hs-CRP (indicator of inflammation) levels, making it possible to predict the process of osteoarthritis in patients with high hs-CRP levels (25). Hs-CRP levels are 10 times higher in moderately obese than in normal body weight people (26). In this study, hs-CRP levels were significantly lower in participants who performed resistance exercise than in non-performing ones, effectively improving osteoarthritis. Triglyceride levels were lower in participants who ate reduced meal volumes for weight loss than in people who did not, although participants who skipped meals exhibited higher triglyceride levels than those who did not. Gradual decrease in meal volumes results in the lowering of triglyceride levels, while skipping a meal results in its increase because radiolysis occurs.

Conclusion

The preferred weight control methods among Korean postmenopausal osteoarthritis patients were exercise, meal volume reduction, functional diet, and skipping meals. Reducing meal volumes was effective for weight control, while exercise (aerobic and resistance) was effective for mental health. Furthermore, hemodynamic variables (particularly hs-CRP levels) were significantly lower in participants who performed resistance exercise.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interest.

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