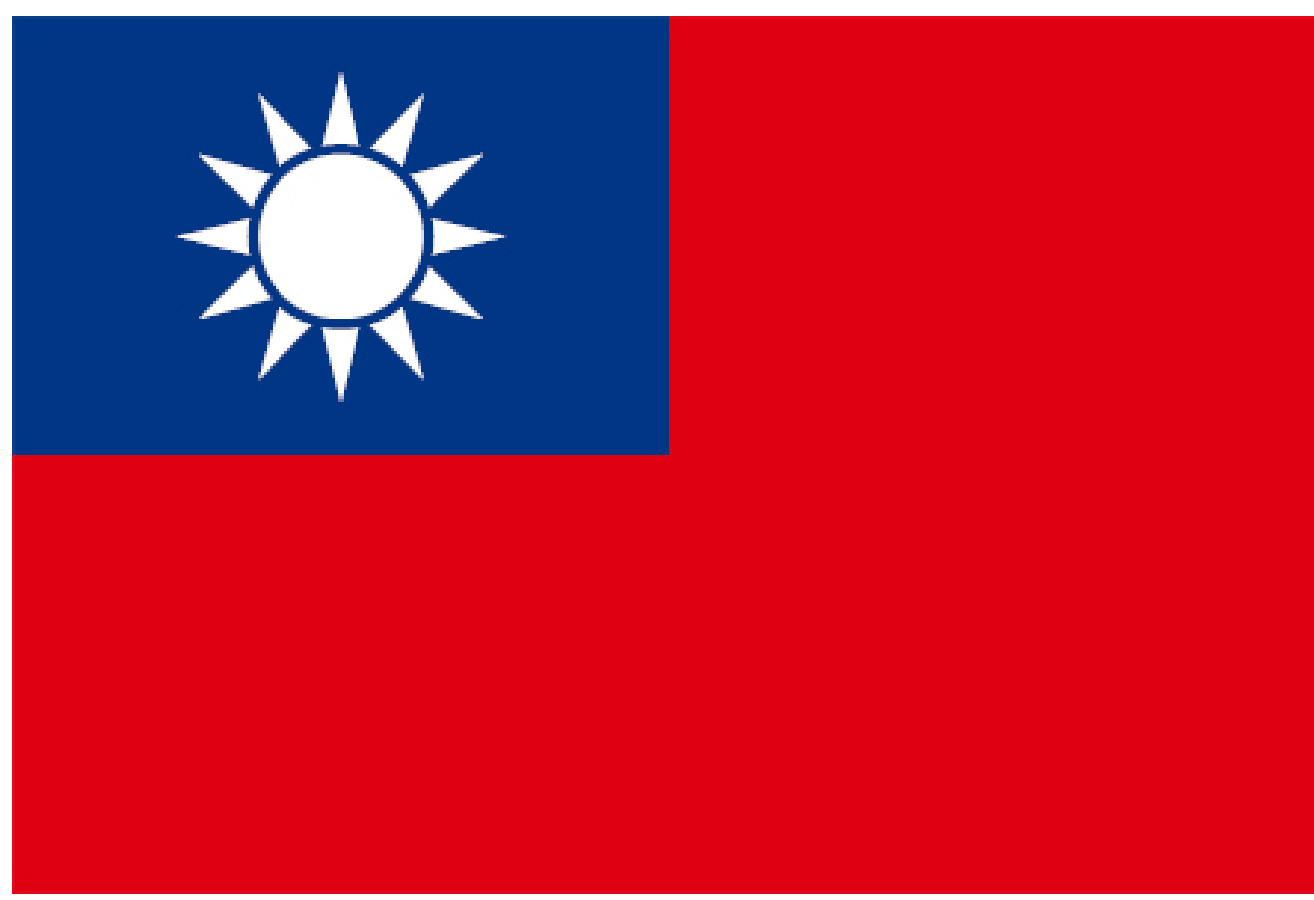




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Effectiveness of Tele-exercise Training on Physical Activity, Cardiorespiratory Fitness, and Health-Related Quality of Life in Patients with Cardiometabolic Multimorbidity

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INTRODUCTION

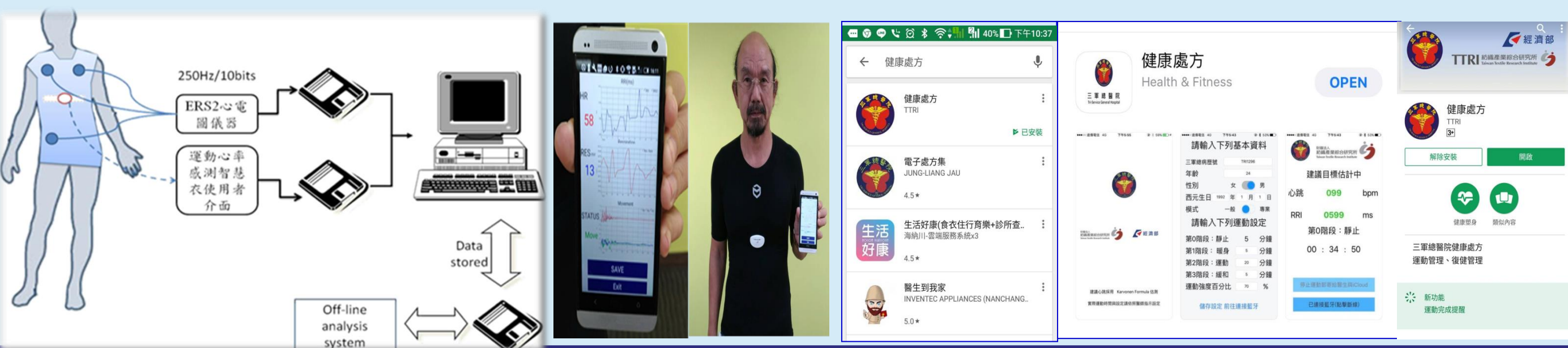
Exercise is beneficial for cardiometabolic health and health-related quality of life (HRQL); however, evidence regarding the effectiveness of the-exercise training on physical activity (PA), cardiorespiratory fitness, and HRQL in patients with cardiometabolic multimorbidity requires further exploration. Therefore, this study aimed to assess whether an assumed increase in PA after tele-exercise training improved cardiorespiratory fitness and HRQL in patients with cardiometabolic multimorbidity.

Methods

1. A randomized controlled trial with 83 Eligible patients with cardiometabolic multimorbidity randomized to either an experimental group (EG, received a 12-week tele-exercise training with 3 sessions/week and 30 min/session) or a control group (CG, usual care only) was conducted. **2.** PA, cardiorespiratory fitness, and HRQL were assessed at baseline and 12 weeks. **3.** Generalized estimating equations were used to examine the intervention effects via the interaction of time and group. **4.** Institutional review board approval was obtained from the local medical center in Northern Taiwan before the commencement of the study. **5.** All participants who provided written informed consent were assured that their participation was entirely voluntary.

Group	Pre-test	Intervention	Post-test (12-week)
Control group	O11		O12
Experimental group	O21	X	O22

Frequency	3 sessions/week
Intensity	70% of the heart rate reserve (resting heart rate + 70% [maximum heart rate – resting heart rate]) based on the Karvonen method during the entire length of the 12-week exercise training program
Time	30 min/session of the main endurance training phase excluding the 5-min warm-up and cool-down down phase
Type	brisk walking, jogging, or stationary ergometer exercise



RESULTS

The EG with higher vigorous-intensity PA ($\beta = 714$, $p = .037$), walking behaviour ($\beta = 750$, $p = .0007$), and total amount of PA ($\beta = 1748$, $p = .001$) after the intervention had significantly elevated cardiorespiratory fitness (VO2peak, $\beta = 3.9$, $p = .042$), and improved HRQL (physical function [$\beta = 7.55$, $p = .03$] and physical component summary [$\beta = 4.42$, $p = .03$]) ($\beta = 5.3$, $p = .025$), compared with the CG.

Table 1. Comparisons of demographic characteristics between control group and experimental group					
Variable	All N = 50	CG n = 25	EG n = 25	χ^2	p
Age (43~70)	60.0 ± 7.2	61.3 ± 4.8	58.8 ± 9.0	1.22	0.23
Sex				6.35	0.01
Male	36 (72.0)	14 (56.0)	22 (88.0)		
Female	14 (28.0)	11 (44.0)	3 (12.0)		
Marital status				4.35	0.06
Married	46 (92.0)	21 (84.0)	25 (100)		
Unmarried	4 (8.0)	4 (16.0)	0 (0)		
Education				2.38	0.12
Under high school	15 (30.0)	10 (40.0)	5 (20.0)		
High school and above	35 (70.0)	15 (60.0)	20 (80.0)		
Occupation				2.38	0.12
Unemployed	15 (30.0)	5 (20.0)	10 (40.0)		
Employed	35 (70.0)	20 (80.0)	15 (60.0)		
Numbers of comorbidities				6.67	0.08
2	22 (44.0)	7 (28.0)	15 (60.0)		
3	19 (38.0)	11 (44.0)	8 (32.0)		
4	7 (14.0)	5 (20.0)	2 (8.0)		
5	2 (4.0)	2 (8.0)	0 (0)		
Hypertension	33 (66.0)	19 (76.0)	14 (56.0)	2.23	0.14
Type 2 Diabetes	14 (28.0)	7 (28.0)	7 (28.0)	0.00	1.00
Hyperlipidemia	35 (70.0)	20 (80.0)	15 (60.0)	2.38	0.12
Heart disease	30 (60.0)	10 (40.0)	20 (80.0)	8.33	0.004
Metabolic syndrome	7 (14.0)	4 (16.0)	3 (12.0)	0.17	0.68
Gout	8 (16.0)	5 (20.0)	3 (12.0)	0.60	0.44
Physical activity level				3.30	0.07
Active	16 (32.0)	11 (44.0)	5 (20.0)		
Sedentary	34 (68.0)	14 (56.0)	20 (80.0)		

Note, Data were presented as numbers (%) or mean ± SD; CG: control group; EG: experimental group; Active: as a moderate physical activity level, 3 or more days per week of vigorous activity of minimum 20 min per day or 5 or more days of moderate-intensity activity or walking for minimum 30 min per day; Sedentary: lower than the moderate physical activity level; p values were from student t test or Chi-square test.

Table 2. Comparisons of physical parameter, physical activity, and patient-reported outcome between baseline and 12-week in both control group and experimental group

Variable	Control group (n = 25)				Experimental group (n = 25)				Between Group (CG vs. EG)			
	Baseline mean (SD)	12-week mean (SD)	t	p ^a	Baseline mean (SD)	12-week mean (SD)	t	p ^a	Baseline t	p ^b	12-week t	p ^b
Exercise capacity												
VO2peak (ml/kg/min)	24.1 (6.5)	24.1 (7.3)	-0.01	0.99	23.2 (6.6)	27.3 (7.1)	-2.06	0.045	0.44	0.66	-1.55	0.13
Workload (Watt)	88.0 (27.9)	88.7 (29.2)	-0.08	0.93	100 (35.0)	116.0 (31.3)	-1.71	0.09	-1.34	0.19	-3.20	0.002
Physical activity												
IPAQ (MET/week)	1128 (788)	1411 (773)	1.28	0.21	1350 (1429)	2898 (2213)	2.94	0.01	0.68	0.50	3.17	0.003
Vigorous-intensity (MET/week)	48.0 (139)	139 (238)	1.66	0.11	409 (1009)	989 (1380)	1.65	0.11	1.64	0.11	3.03	0.01
Moderate-intensity (MET/week)	373 (554)	523 (498)	1.01	0.32	213 (268)	680 (662)	3.27	0.003	-1.30	0.20	0.95	0.35
Walking (MET/week)	707 (382)	748 (507)	0.32	0.75	728 (784)	1229 (1076)	1.88	0.07	0.12	0.91	2.02	0.049
Sitting behavior (min/week)	2806 (1393)	2380 (1457)	-1.06	0.30	2747 (1160)	2032 (1209)	-2.13	0.04	-0.16	0.87	-0.92	0.36
Health-related quality of life												
Physical function	86.0 (7.5)	85.4 (9.0)	0.27	0.79	79.0 (14.7)	85.6 (13.1)	-1.68	0.10	2.12	0.04	-0.08	0.003 ^a
Role-physical	76.5 (25.0)	76.8 (25.9)	-0.04	0.97	61.8 (22.5)	70.5 (23.1)	-1.36	0.18	2.20	0.03	0.90	0.805 ^a
Bodily pain	76.2 (23.3)	69.5 (20.7)	1.07	0.29	82.3 (20.0)	77.7 (19.2)	0.83	0.41	-1.00	0.32	-1.45	0.15
General health	58.0 (25.6)	58.9 (22.9)	-0.13	0.90	53.3 (15.5)	49.4 (16.9)	0.85	0.40	0.79	0.43	1.67	0.10
Vitality	60.5 (15.5)	60.6 (14.7)	-0.02	0.98	59.7 (17.4)	61.5 (11.6)	-0.44	0.66	0.18	0.86	-0.24	0.81
Social functioning	88.0 (17.5)	87.5 (18.8)	0.10	0.92	79.0 (17.9)	79.2 (19.5)	-0.03	0.98	1.80	0.08	1.54	0.13
Role-emotional	88.3 (14.2)	88.7 (16.5)	-0.08	0.94	74.7 (20.8)	71.9 (21.5)	0.46	0.65	2.72	0.01	3.09	0.072 ^a
Mental health	72.4 (11.7)	73.4 (14.8)	-0.27	0.79	67.6 (16.5)	62.8 (16.4)	1.03	0.31	1.18	0.24	2.40	0.02
Physical composite summary	50.3 (7.4)	49.4 (7.4)	0.41	0.69	49.4 (5.4)	52.8 (6.3)	-2.00	0.05	0.46	0.65	-1.72	0.09
Mental composite summary	51.1 (5.9)	51.4 (6.6)	-0.21	0.83	47.0 (8.2)	48.6 (7.7)	-0.71	0.48	2.01	0.05	1.41	0.17

Note, Data were presented as mean (SD); p values were from Independent t test; CG: control group; EG: experimental group. ^a p values were from paired t test; ^b p values were from independent t test; ^a p values were from analysis of covariance after controlling baseline values.

Table 3. Evaluation of the Intervention on Physical parameters, Physical Activity, and Patient-reported outcomes Based on GEE Analysis

Variable	Within-time Ref: baseline		Between-group EG vs. CG		Interaction Group (EG) × Time Ref: (CG) × Time		
	B	p	B	p	B	95% C.I.	p
Exercise capacity							
VO2peak (ml/kg/min)	0.03	0.98	0.58	0.75	4.43	0.31–8.56	0.04
Workload (Watt)	0.68	0.91	10.70	0.19	16.7	-1.33–34.7	0.06
Physical activity							
IPAQ (MET/week)	283	0.17	1408	0.002	1333	425–2241	0.004
Vigorous-intensity (MET/week)	91.2	0.25	688	0.01	513	-94.6–1119	0.10
Moderate-intensity (MET/week)	150	0.18	335	0.03	331	5.02–656	0.04
Walking (MET/week)	40.9	0.73	386	0.22	490	-26.9–1007	0.06
Sitting behavior (min/week)	-426	0.23	276	0.46	-254	-1122–614	0.57
Health-related quality of life							
Physical function	-0.64	0.74	4.99	0.09	7.55	0.84–14.3	0.03
Role-physical	0.25	0.97	-11.7	0.14	8.86	-6.32–24.0	0.25
Bodily pain	-6.68	0.15	4.46	0.46	1.75	-11.6–15.1	0.79
General health	0.88	0.88	10.70	0.12	5.45	-19.0–8.07	0.43
Vitality	0.10	0.98	-7.11	0.16	0.68	-9.90–11.3	0.90
Social functioning	-0.50	0.90	-22.1	<.001	-0.87	-12.8–11.1	0.88
Role-emotional	0.33	0.93	-23.1	0.001	-3.29	-16.8–10.2	0.63
Mental health	1.00	0.76	-22.6	<.001	-6.49	-16.7–3.37	0.19
Physical composite summary	-0.85	0.57	0.30	0.86	4.42	0.45–8.40	0.03
Mental composite summary	0.37	0.81	-8.45	<.001	-0.69	-5.73–4.36	0.79

Note, B: Regression coefficient; C.I., confidence interval; Models were performed by GEE with a Group × Time interaction term characterizing the intervention effect of interest after adjustment for the sociodemographics (i.e., age, gender, marital status, education, and occupation), clinical characteristics (numbers of comorbidities, metabolic syndrome, hypertension, hyperlipidemia, type-2 diabetes, heart disease, and gout), and baseline physical activity level.

CONCLUSIONS

Tele-exercise training was effective in increased PA, elevated cardiorespiratory fitness, and improved HRQL for patients with cardiometabolic multimorbidity, highlighting the feasibility of better delivering PA promotion for cardiometabolic health management.

CONTACT INFORMATION

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