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Original Article

Effects of Elastic Band Resistance Exercise on Physiological Indicators, Depression and Quality of Life of the Elderly in Nursing Homes

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SUMMARY

Background: Sedentary activities are not conducive to the health benefits of elderly residents living in nursing homes. This study explored the effect of a 12-week elastic band resistance exercise (EBRE) on physical function, depression and quality of life (QOL) among the elderly in nursing homes.
Methods: A single-blind experimental design. Eighty elderly from three nursing homes in the south of Taiwan were selected and assigned to the control group (40) and the experimental group (40). The experimental group intervened with regular EBRE for 12 weeks. The control group maintained the original lifestyle and activity. Physiological status, depression and QOL were assessed using tools and instruments with reliability and validity at weeks 4, 8, and 12 during the study period.
Results: After the 12-week EBRE intervention, the grip strength, one of the physiological indicators, was significantly improved at weeks 4, 8 and 12 ($p < 0.05$) with the experimental group. The measured blood oxygen saturation, heart rate, respiratory rate and blood pressure were non-affected. Self-reported depression and QOL were improved ($p < 0.001$) significantly at week 12.
Conclusion: Early intervention of EBRE is an effective method to improve grip strength and QOL and to reduce depression for the elderly living in nursing homes. The results provide empirical evidence for incorporating EBRE into regular activity in nursing homes.

1. Introduction

Taiwan became an aging society in 1993, an aged society in 2018 and is projected to become a super-aged society in 2025; by 2070, 4 out of 10 Taiwanese will be elderly, and 1 out of 4 elderly will be over 85 years old.[1] Long-term care for the elderly of the venerable age has become a challenge for the healthcare professions and authorities in Taiwan.

The residents of long-term care facilities (LTCFs) are largely elderly with progressive loss of muscle mass. Aging and chronic diseases coincide with degenerative changes in motor neurons, protein synthesis and nutritional intake.[2] Muscle mass atrophy during aging adversely affects muscle strength, muscle quality and physical performance, and could lead to sarcopenia that greatly impacts mobility and mortality.[2–4] Muscle strength is an important factor in maintaining gait and balance for the elderly.[4,5] Sedentary lifestyles due to reduced mobility and functional limitations during aging could further worsen physical performance and predispose to an increased risk of falling, disability and mortality.[2–4] Therefore, the efforts of reinforcing muscle strength and reducing falls are emphasized by the majority of disability prevention programs for the elderly.

Depression is a common and disabling disorder.[6] The elderly are fragile with neurobiological changes and important losses that affect their emotions, physical conditions and social performance.[6] Depressive symptoms can be confused by psychological symptoms (e.g. isolation, insomnia, distress and forgetfulness) and somatic complaints.[6,7] Antidepressant drugs are commonly prescribed to treat depressive symptoms for elderly patients that often lead to incidences of fallings, fractures, gastrointestinal and other adverse conditions or even death.[8]

Physical activity is a significant preventive strategy to enhance muscle strength and gait balance in LTCFs.[4] Regular physical activity improves the ability to respond to adversities such as fallings, cardiovascular and metabolic diseases, emotional disorders and depression.[4,9] Engaging in physical activity can lead to alterations in the levels of endorphins and monoamines, or a reduction in cortisol levels, which can enhance mood; it is proposed that physical activity promotes the development of new neurons and the release of proteins like brain-derived neurotrophic factor, which boost the survival of neurons.[6]

Resistance exercise training (RET), a subset of physical activity, is the most employed modality to improve both muscle mass and function.[10] The benefits of RET include building skeletal muscle mass; enhancing muscle strength, flexibility and dynamic balance; improving walking speed; and reducing age-related losses in muscle strength, muscle mass and bone density.[4] Concurrently RET improves physical

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functions, which in term improve quality of life (QOL) and prolong living independently.[4] American College of Sports Medicine recommends progressive RET a minimum of two non-consecutive days per week, with 1–3 sets of 8–12 repetitions in novices.[11]

Thera-band® elastic band (Hygenic Corp.) is equipment used in resistance training. The resistance of an elastic band depends on its thickness and elongation ratio relative to the original length. The elastic band is easy to use and convenient to carry and has a low price and wide application to various activities. The force strength of the elastic band can be controlled by holding the distance between both hands or by the hardness of rubber, allowing users to engage in a wide range of muscle contractions. An elastic band is easy and safe to operate and very suitable for the elderly.[12]

Elastic band resistance exercises (EBREs) as type of RETs work by providing a variable resistance that induces muscle protein synthesis, and increases myofibrillar protein and muscle mass. It also increases the strength and power of muscles, even in older patients. The efficacy of EBREs depends on various factors, including duration, load and frequency of exercises.[13] EBRE has several advantages for older adults: 1) efficiency and with self-perceived efficacy comparable to free-weight resistance training; 2) mild muscle training; and 3) safety.[12]

Early studies and systematic reviews have demonstrated the efficacy of EBREs on physical health and mental health in older adults. A systematic review for EBRE performed as an isolated method on muscle strength and functional performance in healthy adults summarized that EBRE are effective to improve functional performance and muscle strength when compared to no intervention in healthy adults.[14] Another systematic review pooled together 231 older adults with sarcopenia for the effectiveness of EBRE in improving the physical performance after 12 weeks training and identified significant improvements in the timed up and go test, maximal grip strength, gait speed, and appendicular skeletal muscle index in the EBRE group compared with the control group.[12]

Chen et al.[15] evaluated 107 people aged 65 years and above and reported that the muscle strength, grip strength, activities of daily living, and sleeping quality of the old people were significantly improved after 12 months of EBRE intervention. Su et al.[4] studied 61 older adults in LTCFs with the experimental group underwent 3 months of elastic band exercises and demonstrated that the hand muscle strength, balance and lower limb muscle strength in the experimental group had improved significantly than the control group. In the research of Davis et al.,[5] a brief EBRE with eight movements in the hip and chest regions was devised in a balance challenge to measure changes in heart rate and rate of perceived exertion and to identify the major themes (e.q. exercise selection, exercise equipment and environment) associated with the flexibility of the EBRE. De Oliveira et al.[16] included 22 older adults for investigating functional capacity and found significant improvements in the timed up and go, the sit-and-stand test, the elbow flexion test and the right and left knee extensor tests after 8 weeks of concurrent EBRE. Stojanović et al.[17] investigated the effects of 12 weeks of chair-based, low-load EBRE on functional fitness (30-chair stand, 30-arm curl, 2 min step test, chair sit-and-reach, back scratch, 8-foot up-and-go, handgrip strength) and metabolic biomarkers (fasting blood glucose, triglycerides, total cholesterol, high and low density lipoprotein) in older women and found significant improvements in functional fitness tests and all but one (triglycerides) biomarkers.

Based on the above mentioned findings, this study sought to investigate the effectiveness of an EBRE experiment on the physical and mental health as well as QOL of the elderly residents living in nursing homes.

2. Methods

2.1. Study design, participant sand settings

A single-blind experimental study was conducted. Based on previous findings on the effects of elastic band exercises,[4] a sample size of 40 per group was required for an expected effect size of 0.4, alpha 0.05, power 0.8, correlation among four repeated measures 0.5 and drop-out rate 10%. The inclusion criteria were as follows: age of 65 years and above; ability to walk independently or with assistive devices such as walking aids or to move in a wheelchair; ability to communicate in Mandarin or Taiwanese; normal cognitive function; and ability to follow instructions and perform simple activities. The elderly from three nursing homes in the south of Taiwan were recruited for the study. The elderly were approached by the investigators with the help of the staffing nurses of each nursing home. After the initial face-to-face introduction, the elderly were generally cooperative. The recruitment process was based on trust in staffing nurses and the investigators.

The participants were randomly and evenly divided using sealed envelopes into either the experimental group or the control group. The division of the participants was arbitrary not by nursing homes. Study variables were measured at four time points, first, 4th, 8th and 12th week. Two staff nurses in each of the nursing homes were invited to take charge of collecting raw data. These nurses were gathered and trained to accord with the collection procedure. At the end of the research, the EBRE movements were also demonstrated to the control group. A total of 82 subjects, 41 in each group, met the inclusion criteria and agreed to participate. During the research period, one subject quit from the experimental group and one from the control group due to hospitalization. To achieve single blindness, only primary investigators revealed how the participants were allocated. The study flow is depicted in Figure 1.

2.2. Intervention

The EBRE exercise was comprised of 12 movements: (1) lifting the hands at sides straightly and extending them outward; (2) extending the hands up and down; (3) hands up, with the elastic band stretching behind the left and right sides of the body; (4) practicing boxing forward and keeping the arms as straight as possible; (5) practicing boxing left and right; (6) crossing the arms forward; (7) straightening the chest and bending the torso forward; (8) pressing elbows close, with bent forearms; (9) lifting diagonally on both sides; (10) opening out the thighs to the left and right; (11) marching on the spot; and, (12) keeping the arms fixed and straightening the thighs forward.

The EBRE sessions were led by a rehabilitation therapist who was certified for EBRE instruction. The movements were decomposed and performed step-by-step in first two weeks. Eight to twenty participants joined together forming a group to avoid forgetting steps and practiced in an environment of gentle background music. The participants' adjusting motions were assisted by the caregivers to secure safety. If any of the participants felt uncomfortable or overly strenuous, the practice would pause then decide whether to continue the exercise. The training sites chosen were indoor with good ventilation and spacious enough to keep a distance of 150 cm between two persons. The EBRE sessions always occurred in the morning hours three times per week with a duration of 30 minutes for 12 consecutive weeks. During the research period, the control group remained on the originally planned activities, such as art and craft or singing.

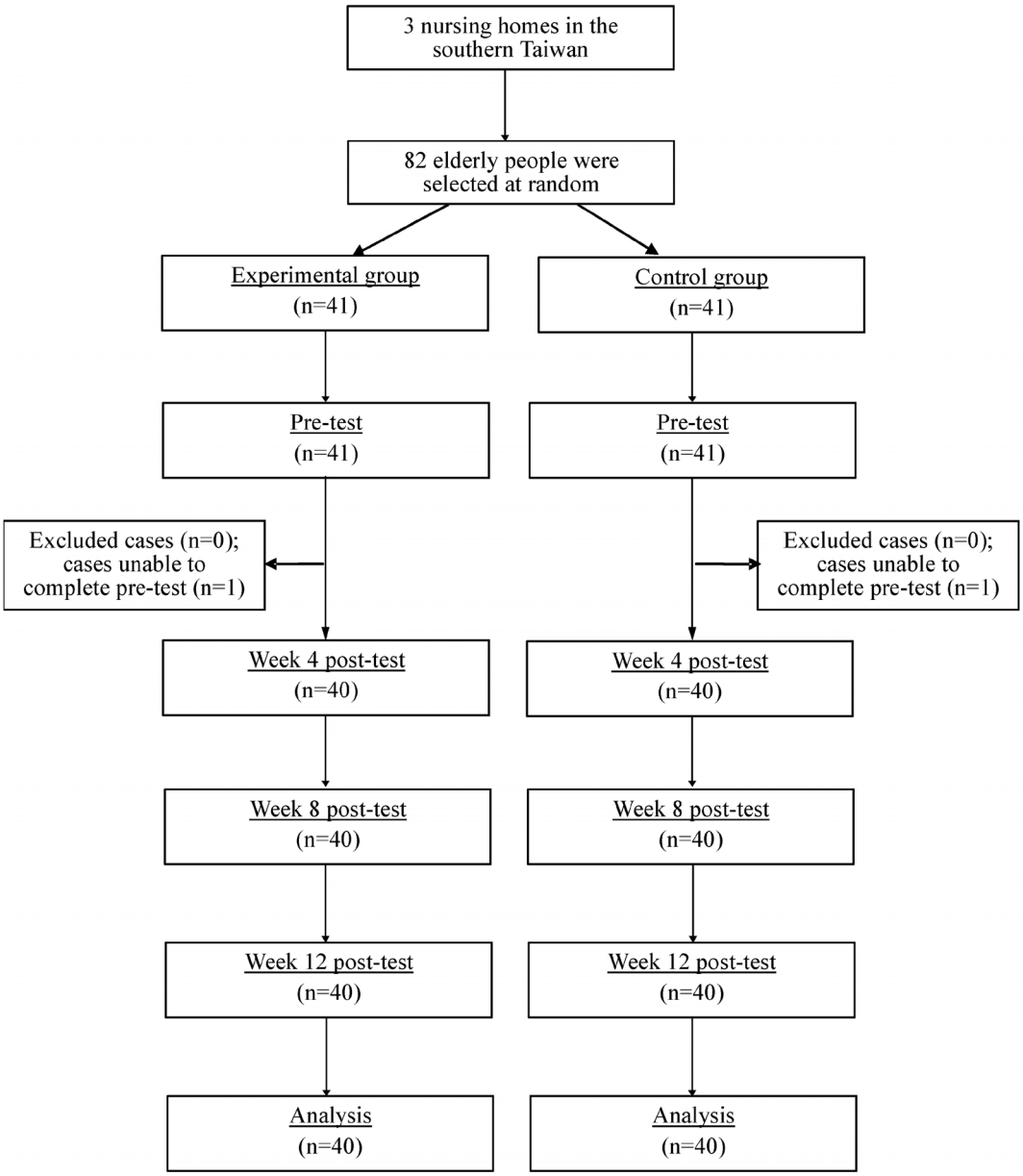

Figure 1. Flowchart of study case randomization and data collection.

2.3. Outcome variables and study instruments

A questionnaire was designed with composite items in four categories: (1) basic demographic, living status and chronic disease: age, gender, marital status, education level, religious beliefs, living status before nursing homes and chronic diseases; (2) physiological indicators and grip strength: blood oxygen saturation, heart rate, respiratory rate, blood pressure, and grip strength monitored within 5 minutes after 30 minutes of exercise; (3) depressive symptoms: the Geriatric Depression Scale-Short Form (GDS-SF) from the Geriatric Depression Scale by Sheikh and Yesavage;[18] and, (4) self-reported QOL: the brief version of World Health Organization Quality of Life Questionnaire (WHOQOL-BREF), Taiwan version.

The GDS-SF questionnaire contains 15 questions with a total score of 15 points: 1–5 points indicate good mental health; 6–9 points indicate mild depressive tendencies and further evaluation is required; and ≥10 points indicate depression, and the participant should be given active care and transferred to a professional unit. Elderly people in nursing homes should answer the questions according to their feelings in the past week. If their feelings met the description, then they answered "Yes"; otherwise, they answered "No". Higher scores indicate more severe depression. This scale has a sensitivity of 0.72 and a specificity of 0.57 in the diagnosis of depression, with good reliability (Cronbach's α = 0.89) and test-retest reliability (r = 0.51–0.67).[19] The Cronbach's α value of GDS-SF calculated for this study was 0.91.

The WHOQOL-BREF questionnaire contains 28 items, 2 items of a global scale and 26 items in four domains: (1) seven items in physical health; (2) six items in psychological health; (3) four items in the domain of social relations; (4) nine items in environmental health. The items in the global scale are overall QOL and general health. All items are of the 5-point Likert scale. Higher scores indicate a better QOL. The questionnaire shows good psychometric properties with internal consistency in all four domains (Cronbach's α: 0.70–0.77) and test-retest reliability in 2–4 weeks (0.41–0.79 at item/facet level; 0.76–0.80 at domain level).[20] The values of Cronbach's α in all four domains of WHOQOL-BREF ranged from 0.86 in psychological health to 0.95 in social relations.

2.4. Statistical analysis

For statistical analysis, the means, standard deviations, paired *t*-tests, and Generalized Estimating Equations (GEE) tests were performed using Personal Computer software SPSS 21.0 for Windows. GEE is a semi-parametric method for modeling longitudinal or clustered data. It is intended for repeated measures and it can be used with non-normal data. Importantly, GEE uses all available data for each subject. All *p* values (< 0.05) indicate statistical significance.

2.5. Ethic considerations

This research was reviewed and approved by the Institutional Review Board of Changhua Christian Hospital (IRB No.190112). The consent of participants and their families was sought before they filled out the consent form. The research process strictly adhered to the rights of the participants and in accordance with the ethical guidelines of the Research Ethics Committee.

3. Results

3.1. Demography attributes of research subjects and homogeneous comparison between two groups

The participants were largely aged 75 years old and above (85%), females (52, 65%), married (60%), illiterate (47.5%), religious (80%) and living with families before nursing home (83.8%). Chi-square tests compared the characteristics in demographics, living status before nursing homes and chronic diseases between the two groups. Non-significant differences were found in all attributes between the two groups indicating the homogeneity of the residents of the two groups (Table 1).

3.2. Effect of EBRE on the physiological indicators of the elderly in nursing homes

The paired *t*-tests for blood oxygen saturation, heart rate, respiratory rate and blood pressure at pretest and 12 weeks indicated no significant differences between the two groups; however, grip strengths were significantly improved in both groups but greater in the experimental group (Table 2). The GEE test for grip strength showed significant effects of the EBRE intervention at 4, 8 and weeks 4, 8, and 12 (Table 3).

3.3. Effect of EBRE on the depression of the elderly in nursing homes

The mean of the GDS-SF scores in the experimental group decreased by 0.73 ± 0.6 points from 1.70 ± 1.09 of the pre-test after the 12-week period; a significant change ($p < 0.001$) was shown by

Table 1
Comparison of demographic attributes between the experimental and control group (N = 80).

Attributes	Experimental (N = 40) N (%)	Control (N = 40) N (%)	All N (%)	χ^2	*p*-value
Age				0.541	0.763
65–74 y/o	6 (15)	6 (15)	12 (15)		
75 y/o or above	34 (85)	34 (85)	68 (85)		
Gender				0.220	0.407
Female	25 (62.5)	27 (67.5)	52 (65)		
Male	15 (37.5)	13 (32.5)	28 (35)		
Marital status				0.833	0.247
Married	26 (65)	22 (55)	48 (60)		
Others	14 (35)	18 (45)	32 (40)		
Education level				0.055	0.824
Illiterate	22 (55)	16 (40)	38 (47.5)		
Elementary school	9 (22.5)	21 (52.5)	30 (37.5)		
Middle school or above					
Religious beliefs				1.250	0.201
No	10 (25)	6 (15)	16 (20)		
Yes	30 (75)	34 (85)	64 (80)		
Living status before nursing homes				0.827	0.273
Living with families	32 (80)	35 (85.7)	67 (83.8)		
Others (living alone, care institutions)	8 (20)	5 (12.5)	13 (16.2)		
Chronic diseases				5.000	0.220
1–2	15 (37.5)	25 (62.5)	40 (50)		
3 or more	25 (62.5)	15 (37.5)	40 (50)		

Table 2
Comparison of pre- and post-test scores among physiological indicators and grip strength of the elderly in nursing homes (N = 80).

Measurement	Time	Experimental group (N = 40)	Paired-*t* test		Control group (N = 40)	Paired-*t* test	
		mean ± SD	*t* value	*p* value	mean ± SD	*t* value	*p* value
Oxygen saturation (SpO2)	Pre test	98.7 ± 0.6	-2.205	.060	98.8 ± 0.4	-1.403	.168
	12 weeks	99.0 ± 0.5			98.9 ± 0.4		
Heart rate	Pre test	73.8 ± 12.6	-.721	.475	75.1 ± 10.4	.337	.738
	12 weeks	75.0 ± 11.7			74.4 ± 9.9		
Respiratory rate	Pre test	15.7 ± 1.8	-.138	.891	15.9 ± 1.9	.635	.529
	12 weeks	15.7 ± 2.1			15.8 ± 1.8		
Systolic BP (mmHg)	Pre test	127.4 ± 15.7	-.149	.883	132.1 ± 12.9	-.675	.504
	12 weeks	127.9 ± 18.5			134 ± 16.5		
Diastolic BP (mmHg)	Pre test	70.3 ± 11.6	-1.833	.074	73.3 ± 9.9	-.576	.568
	12 weeks	74.4 ± 12.1			75.2 ± 19.4		
Grip strength, right (kg)	Pre test	8.3 ± 6.6	-6.229	< .000***	3.9 ± 5.4	-3.375	.002**
	12 weeks	10.6 ± 7.5			4.7 ± 6.1		
Grip strength, left (kg)	Pre test	7.7 ± 6.0	-6.340	< .000***	3.8 ± 5.3	-3.355	.002**
	12 weeks	9.4 ± 6.4			4.5 ± 6.2		

** $p < 0.01$; *** $p < 0.0001$.
BP = blood pressure; SD = standard deviation.

paired *t*-test. The mean value of GDS-SF scores in the control group also decreased by 2.73 (±1.13) points from 2.75 (±1.17) points of the pre-test; however, a non-significant decrease was shown by paired *t*-test as well. The GEE test for GDS-SF scores showed a significant effect at 12 weeks (β = -0.95, $p < 0.0001$) but no significant effect in 4 or 8-week periods. In the experimental group, the GDS-SF score was significantly lower by .93 after 12 weeks of EBRE training ($p < 0.0001$) shown in Table 4.

3.4. Effect of EBRE on the QOL of the elderly in nursing homes

The scores of WHOQOL-BREF were improved significantly in the experiment group after the 12-week period analyzed by paired *t*-tests ($p < 0.001$); however, for the control group, the total scores and the four domains (i.e. global, psychological, environmental and social relationship) were statistically improved as well (Table 5). The GEE test for WHOQOL-BREF scores indicated a positive effect of the EBRE on the 12-week period (β = 1.45, $p < 0.0001$) but the effects on the 4- and 8-week periods were non-significant statistically. For the experimental group, the total score of WHOQOL-BREF was significantly higher by 8.22 after 12 weeks of EBRE training ($p < 0.0001$) shown in Table 6.

4. Discussion

4.1. Effect of EBRE on physiological indicators and grip strength

Handgrip strength is proposed as a convenient prognostic tool and is found to be positively correlated with physical function in older adults.[4,21] The improvement in grip strength may significantly improve the ability to perform activities such as combing hair, dressing, and bathing.[4,15] After performing the EBRE for 12 weeks, the experimental group in this study showed significant improvements in grip strength compared to the control group. This finding was in parallel to those found in previous studies.[4,15,17,21]

No significant change in blood pressure was found in either the experimental or control group. The changes in other physiological indicators were similarly non-significant. Blood pressure is influenced by chronic diseases and drug regimens thereby making it difficult to control by short-term programs such as the EBRE in this study. The finding of this study was similar to a previous study.[4]

4.2. Effect of EBRE on depressive symptoms

Examining the pretest scores in both groups showed that fewer depressive symptoms were detected and the experimental group relatively more symptomatic whereas the posttest scores showed that depressive symptoms were reduced in both groups and a greater reduction in the experimental group. These findings indicated that the elderly in both groups were emotionally stable and EBRE was effective in mitigating depressive symptoms. Similar effects of physical activity on depressive symptoms were demonstrated by previous studies and systematic reviews.[6,7,22] The reduction of depression levels after physical exercise programs is probably due to multiple mechanisms that started from increasing the physical functioning and reducing the dependence levels of these elderly; next, the increase of independence in activities of daily living brings additional effects that build their self-esteem and sense of control

Table 3
Effect of EBRE on grip strength of the elderly in nursing homes (N = 80).

Effect	B	SE	95% CI	Wald χ^2	*p* value
Right hand					
Intercept	4.258	7.934	[-11.294, 19.809]	0.288	0.592
Groups (experimental group)	6.711	8.686	[-10.314, 23.736]	0.597	0.440
Time (4 weeks)	-1.525	0.415	[-2.338, -0.712]	13.508	0.045*
Time (8 weeks)	-0.963	0.292	[-1.535, -0.390]	10.848	0.001**
Time (12 weeks)	-0.263	0.131	[-0.519, -0.006]	4.014	< 0.000***
Groups (experimental group) × Time (4 weeks)	0.338	0.119	[0.104, 0.571]	8.031	0.005**
Groups (experimental group) × Time (8 weeks)	1.513	0.247	[1.029, 1.996]	37.640	< 0.000***
Groups (experimental group) × Time (12 weeks)	2.250	0.357	[1.551, 2.949]	39.803	< 0.000***
Age†	-3.429	3.258	[-9.816, 2.957]	1.108	0.293
Left hand					
Intercept	0.533	6.567	[-12.338, 13.404]	0.007	0.935
Groups (experimental group)	1.636	5.744	[-9.622, 12.894]	0.081	0.776
Time (4 weeks)	-1.025	0.339	[-1.689, -0.361]	9.167	0.042*
Time (8 weeks)	-0.725	0.270	[-1.254, -0.196]	7.227	0.007**
Time (12 weeks)	-0.150	0.093	[-0.332, 0.032]	2.609	< 0.000***
Groups (experimental group) × Time (4 weeks)	0.200	0.086	[0.031, 0.369]	5.378	0.020*
Groups (experimental group) × Time (8 weeks)	1.275	0.215	[0.854, 1.696]	35.161	< 0.000***
Groups (experimental group) × Time (12 weeks)	1.725	0.269	[1.198, 2.252]	41.230	< 0.000***
Age†	-1.377	2.440	[-6.159, 3.406]	0.318	0.573

* $p < .05$; ** $p < .01$; *** $p < .0001$; † covariate.
EBRE = elastic band resistance exercise.

Table 4
Effect of EBRE on GDS-SF scores of the elderly in nursing homes (N = 80).

Effect	B	SE	95% CI	Wald χ^2	*p* value
Intercept	-0.139	1.032	[-2.161, 1.884]	0.018	0.893
Groups (experimental group)	1.030	0.245	[0.549, 1.511]	17.633	< 0.000***
Time (12 weeks post-test)	-0.950	0.117	[-1.179, -0.721]	65.936	< 0.000***
Groups (experimental group) × Time (12 weeks post-test)	-0.925	0.125	[0.681, 1.169]	55.035	< 0.000***
Age†	0.022	0.012	[-0.002, 0.046]	3.337	0.068

*** $p < 0.0001$.
B = beta estimate; CI = confidence interval; EBRE = elastic band resistance exercise; GDS-SF = Geriatric Depression Scale-Short Form; SE = standard error.

Table 5
WHOQOL-BREF pre- and post-test scores comparison of the elderly in nursing homes (N = 80).

Domain	Time	Experimental group (N = 40)	Paired-*t* test		Control group (N = 40)	Paired-*t* test	
		mean ± SD	*t* value	*p* value	mean ± SD	*t* value	*p* value
Total score	Pre test	67.7 ± 10.6	10.373	< 0.000***	56.3 ± 11.7	5.259	< 0.000***
	12 weeks	77.4 ± 6.3			57.7 ± 11.1		
Overall quality of life and general health	Pre test	14.0 ± 3.1	6.670	< 0.000***	11.0 ± 3.1	2.243	0.031*
	12 weeks	16.2 ± 1.6			11.4 ± 3.1		
Physical health	Pre test	13.0 ± 2.3	9.107	< 0.000***	11.4 ± 2.0	-1.279	0.208
	12 weeks	15.3 ± 1.4			11.2 ± 2.3		
Psychological health	Pre test	14.0 ± 2.2	8.480	< 0.000***	11.4 ± 2.1	5.041	< 0.000***
	12 weeks	15.9 ± 1.4			11.7 ± 2.1		
Environmental health	Pre test	13.9 ± 2.1	9.255	< 0.000***	11.6 ± 2.4	5.034	< 0.000***
	12 weeks	15.9 ± 1.3			12.5 ± 1.7		
Social relationships	Pre test	12.9 ± 2.1	6.296	< 0.000***	11.0 ± 2.7	0.374	0.711
	12 weeks	14.2 ± 1.7			11.0 ± 2.5		

* $p < 0.05$; *** $p < 0.0001$.
SD = standard deviation; WHOQOL-BREF = the brief version of World Health Organization Quality of Life Questionnaire.

Table 6
Effect of EBRE on WHOQOL-BREF scores of the elderly in nursing homes (N = 40).

Effect	B	SE	95% CI	Wald χ^2	*p* value
Total score					
Intercept	75.250	10.138	[55.379, 95.121]	55.089	< 0.000***
Groups (experimental group)	11.242	2.416	[6.508, 15.977]	21.660	< 0.000***
Time (12 weeks post-test)	1.453	0.273	[0.918, 1.987]	28.362	< 0.000***
Groups (experimental group) × Time (12 weeks post-test)	8.220	0.961	[6.337, 10.103]	73.167	< 0.000***
Age†	-0.231	0.123	[-0.471, 0.009]	3.557	0.059
Overall quality of life and general health					
Intercept	14.811	2.596	[9.723, 19.899]	32.554	< 0.000***
Groups (experimental group)	2.959	0.684	[1.617, 4.300]	18.691	< 0.000***
Time (12 weeks post-test)	0.400	0.176	[0.055, 0.745]	5.161	0.023*
Groups (experimental group) × Time (12 weeks post-test)	1.850	0.377	[1.112, 2.588]	24.113	< 0.000***
Age†	-0.046	0.031	[-0.107, 0.016]	2.127	0.145
Physical health					
Intercept	13.895	2.116	[9.748, 18.042]	43.124	< 0.000***
Groups (experimental group)	1.542	0.472	[0.617, 2.466]	10.672	< 0.000***
Time (12 weeks post-test)	-0.198	0.152	[-0.496, 0.101]	1.679	0.050
Groups (experimental group) × Time (12 weeks post-test)	2.480	0.291	[1.910, 3.050]	72.803	< 0.000***
Age†	-0.032	0.025	[-0.081, 0.018]	1.564	0.211
Psychological health					
Intercept	14.362	2.104	[10.237, 18.487]	46.575	< 0.000***
Groups (experimental group)	2.596	0.470	[1.675, 3.517]	30.535	< 0.000***
Time (test after 12 weeks)	0.338	0.066	[0.208, 0.467]	26.059	< 0.000***
Groups (experimental group) × Time (12 weeks post-test)	1.525	0.227	[1.081, 1.969]	45.241	< 0.000***
Age†	-0.038	0.025	[-0.087, 0.012]	2.232	0.135
Environmental health					
Intercept	14.935	1.882	[11.246, 18.623]	62.979	< 0.000***
Groups (experimental group)	2.276	0.491	[1.313, 3.238]	21.479	< 0.000***
Time (12 weeks post-test)	0.890	0.175	[0.548, 1.232]	25.994	< 0.000***
Age	-0.041	0.022	[-0.085, 0.003]	3.331	0.068
Social relationships					
Intercept	17.299	2.423	[12.550, 22.049]	50.963	< 0.000***
Groups (experimental group)	1.882	0.517	[0.868, 2.896]	13.225	< 0.000***
Time (12 weeks post-test)	0.025	0.066	[-0.104, 0.154]	0.143	0.050
Groups (experimental group) × Time (12 weeks post-test)	1.250	0.211	[0.837, 1.663]	35.236	< 0.000***
Age†	-0.076	0.029	[-0.132, -0.019]	6.838	0.059

* $p < 0.05$; *** $p < 0.0001$.
B = beta estimate; CI = confidence interval; EBRE = elastic band resistance exercise; GDS-SF = Geriatric Depression Scale-Short Form; SE = standard error.

which may help reduce depressive symptoms.[22]

4.3. Effect of EBRE on QOL

Examining the pretest and posttest scores showed that the elderly in the control group (56.3 vs. 57.7) were probably had worse QOL and dissatisfied with their health whereas the elderly in the experimental group (67.7 vs. 77.4) with better QOL and satisfied with their health. Examining the significant improvements in both groups showed that some of the WHOQOL-BREF domains (i.e. psychological and environmental health) were improved in the control group whereas all domains were improved. These findings indicated the

effect of EBRE on QOL for the elderly living in nursing homes. This was consistent with the findings of a previous survey.[23] Physical activity is an important determinant of QOL and decreased QOL is often associated with the prevalence of psychosomatic and motor function disorders as well as with impaired social performance.[23]

4.4. Limitations

This study was limited by including only three nursing homes with fewer cases. Therefore, the results might not be generalizable to all elderly in nursing homes. Since the participants in this study were predominantly female, the effects of the intervention on male subjects cannot be fully determined. Furthermore, the participants in the study had lived in nursing homes for at least six months and thus were emotionally normal with the absence of depressive symptoms; this could impede the effects of the intervention. Future studies should address issues such as the ratio of male vs. female participants, larger sample size, the duration of living in nursing homes, etc. Many Taiwanese elderly prefer to live with family and their willingness to move to nursing homes only under the circumstances when their family is unable to care for them; living in nursing homes becomes a second choice and a source of stressor for these elderly. Exercise interventions are well suited for these elderly as they are required to adapt to a new life living in the nursing home and as the distraction of their attention during the initial transitional period.

5. Conclusion

The EBRE is a safe and easy-to-learn resistance exercise. Elastic bands are lightweight and suitable for the elderly to carry. This study focuses on a safe and easy-to-learn EBRE program designed for the elderly living in nursing homes. The participants had improved their grip strengths, depressive symptoms and QOL after the intervention. Regular and continuous EBRE programs are recommended for this population.

Conflicts of interest

All authors have no conflicts of interest to declare.

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