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Research Article

Effects of Exercise Behavior, Social Cohesion, and Social Support on Health Behaviors in Older Adults: Intervention in a Multi-Component Exercise Program

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Abstract

Participation in group physical activity by older adults contributes to relationships and health; it is the most effective way to promote physical and mental health. The purpose of this study was to intervene with a multi-component exercise program to understand exercise behavior, social cohesion, and social support with the older adult explanatory power for health behavior. This study recruited 100 healthy people (50 males and 50 females) over 65 years old (average male age: 76.57 ± 1.46 years; average female age: 74.73 ± 1.68 years). Participants implemented an 8-week multi-component exercise program intervention, and before and after the intervention, the Senior Fitness Test for older adults, the Exercise Behavior, Social Cohesion, and Social Support Questionnaire for older adults and Health Behavior Inventory for older adult were implemented. The results of the study showed that the SFT data in male and female older adults could help improve balance and upper and lower extremity muscle strength. For the HBI test of all participants, in order to avoid tobacco, alcohol, and drug use, they could exercise at least three days per week, for more than 30 minutes each time, mainly outdoor exercise. In this study, exercise behavior had the greatest explanatory power on the health behaviors of older adults, followed by social support and social cohesion, which also had a high predictive power on the health behavior of older adults. Finally, the interventions of the multi-component exercise program in this study were shown to positively affect the older adults' exercise behavior, social support, and social cohesion, with a total positive effect on health behavior. The value of this study is helpful for older adults to adopt outdoor group exercise; creating social opportunities in this way is good for mental health, which, in turn, leads to improved physical and mental health.

Keywords: Physical activity; Multi-component exercise program; Fall prevention; Social cohesion; Social support; Exercise intervention

Introduction

According to the definition from the World Health Organization (WHO), when the proportion of adults aged over 65 years old accounts for 20% of the total population, a society is defined as 'super-aged' [1]. It is estimated that by 2026, Taiwan's older adult population will result in a super-aged society; by then, there will be one older adult in every four to five people [2]. Moreover, physical activity levels decline and health status deteriorates with age, and some older adults with chronic illnesses may become inactive [3]. Some studies have shown that physical activity provides health benefits regardless of chronic disease [4]. Population aging is a global phenomenon, and older adults generally care most about their health [5]; from the perspective of preventive medicine, good exercise behavior of older adults plays an important role in achieving healthy behavior, and can also delay

disease or disability associated with aging [6]. The World Health Organization has posited the problem of physical activity in the health behavior of older adults, mainly due to the lack of intensity and exercise time during exercise [7].

First of all, the so-called 'health behavior' refers to various activities performed to enhance physical fitness, maintain and promote physical and mental health, and avoid disease. It is the behavioral performance of an individual in a good state in terms of physical, psychological, and social adaptation [8,9]. Many scholars have conducted factor analysis on health behaviors [9-12], and the comprehensive results can be roughly divided into healthy eating behaviors, health care behaviors, emotional and stress management, physical activity, and changing behaviors that are harmful to health (such as the cessation of smoking and alcohol, gambling cessation) and five other categories. The definition of so-called exercise behavior, in a broad sense, refers to physical exercise performed by skeletal muscles that consume energy, including leisure time, housework, occupational work, etc. [13]. In a narrow sense, it refers to physical exercise performed during leisure time, and thus must include exercise intensity and exercise time [1]. In this study, the exercise behavior of older adults was defined according to the WHO. Older adults (over 65 years) should perform at least 150-300 minutes of moderate-intensity exercise per week, or at least 75-150 minutes of high-intensity exercise, or moderate-intensity and a combination of high-intensity activities and multiple days of physical activity on three or more days per week, emphasizing body balance and upper and lower extremity muscle strength training [1]. The promotion of exercise behavior is through understanding, control, and planning [14-16]; therefore, the primary motivation of this study was emphasize the importance of physical activity to older adults from practical actions through a multi-component exercise program, and then achieve autonomous exercise behavior. In addition, scholars have pointed out that factors such as gender, age, education level, marital status, smoking habits, drinking habits, and current living conditions all affect the exercise behaviors of older adults [17-21]. Therefore, these factors were included as background variables for the participants in this study. As for the factors that exercise behavior in-directly affects health behavior, evidence has shown that exercise behavior is positively correlated with healthy body weight and dietary intake [22-24]. Exercise is hypothesized to be inversely related to smoking and drinking [25]. In recent years, people have begun to pay attention to the mental health of different age groups. There is evidence that exercise can relieve stress [26], reduce anxiety levels [27], reduce the breadth and depth of depression [28], and promote mental health [29]. However, the functional de-cline in older adults and their spouses, and the high risk of cognitive decline, lack of social activities, and less support from group partners can easily induce the psychological pressure of loneliness and helplessness in older adults. Therefore, this study used a multi-sports intervention program (exercise behavior) to create opportunities for group sports (social support and social cohesion) [30], and determine its impact on the health behavior of older adults. Social cohesion is usually defined as a feeling of mutual trust, close connection, willingness to help each other, and shared values among members of a common group [31]. The level of social cohesion maintains the strength of a group connection. Nowadays, groups use social networks to form com-mon groups (such as Line groups, Facebook, Twitter, and Myspace), and share activity information with group members. When members are under high pressure, or when they are depressed, they will also provide support to their partners in the group, which is a manifestation of high cohesion [32,33]. Group activities are becoming more and more important in the social life of older adults, and people are paying more and more attention to maintaining the connection and cohesion of the living environment of older adults, which is also an important way to prevent loneliness [34]. Therefore, increasing social interaction and social cohesion through community activities, schools for older adults, volunteer service groups, and participation in religious activities can prevent loneliness and promote mental health [35]. In addition, studies have pointed out that if older adults have positive social cohesion, this has a positive impact on mental health and can reduce depression, hopelessness, and loneliness [36]. It has been reported that older adults with low social cohesion are more likely to have limited physical activity than those with high social cohesion [37], and older adults with low social cohesion may have physical disabilities which prevent them from participating in activities outside [38,39]; some older adults may be afraid that they will suffer injuries when going out [40]. Therefore, studying social cohesion in older adults is another motivation for promoting healthy behaviors in older adults.

Social support is broadly defined as a person being cared for and receiving assistance when needed [41], which is mainly provided by family members, close friends, and organizational members (such as community, neighborhood, or religious group) [42]. Older adults receive social support from significant others, and can receive emotional support (including a sense of belonging, empathy, and being valued), support for material assistance, and support for information feedback [43]. Older adults are likely to devote time and energy to close friends and family, who are the main sources of social support for older adults after they retire. Many studies have confirmed that social support for older adults is important for physical activity, diet, and adherence to medication [44-46], and that support from friends or significant others helps to avoid developing smoking and drinking habits [47,48], as well as participating in community activities or religious groups to meet friends of different ages [49], all of which are so-cially supported by older adults' source and efficacy. Therefore, this study employed the factor of "social support" as another motivation in order to understand the benefits of health behaviors in older adults.

The psychological factors of older adults should be taken into consideration when exercising. If they are forced to exercise or are afraid of injury and do not have the confidence to do it, even if the exercise itself is effective, older adults will not persevere at all. Guiding older adults is therefore important for adherence to exercise [50]. Many scholars have put forward opinions on exercise compliance from different factors, including the content of each exercise, attendance rate [51], exercise continuity [52], exercise intensity persistence [52,53], etc. These factors can strengthen exercise effects, i.e., exercise compliance. Based on the above literature and the exercise compliance of older adults, this study adopted group activities and multi-component exercise program as an intervention measure, aiming to solve the following two problems: (1) Does a multi-component exercise program intervention help to improve the health behavior of older adults?; (2) Can exercise behavior, social cohesion, and social support effectively predict the health behavior of older adults after a multi-component exercise program intervention? Based on the research questions, the following hypotheses of this study were proposed. Hypothesis 1: multi-component exercise program interventions contribute to the promotion of healthy behaviors in older adults; Hypothesis 2: exercise behavior, social cohesion, and social support can effectively predict the health behaviors of older adults after the intervention of a multi-component exercise pro-gram.

Materials and Methods

This study used an original population (healthy older adults over 65 years old in Taipei City) to recruit; therefore, there was no random arrangement to be tested, and there was no control group for relative comparison would be directly affected by many variables. Therefore, the variables that might affect the experimental results in the experimental process were controlled and limited. The control variables were discussed in the article, so this type of experiment belongs to the one-group pretest-posttest de-sign [54].

Research Framework

The intervention measures in this study adopted a multi-component exercise program, which combined a variety of exercise elements and was taught by participating research members. In order to arouse the older adults' awareness and interest in exercise, in addition, this program adopted a group exercise method. In order to apply the effect of group strength, mutual encouragement, companionship, and proximity to a crowd to achieve cohesion and social opportunities for older adults, the research framework was established based on these viewpoints, as shown in Figure 1.

This study designed the "Exercise Behavior, Social Cohesion, and Social Support Scale" for older adults were designed and integrated into one questionnaire, and combined with the "Healthy Behavior Questionnaire for older adults, as well as an 8-week multi-component exercise program (walking, resistance training, and yoga) was implemented between the pre- and post-test of the two questionnaires. First, the differences in different background variables among older adults on exercise behavior, social cohesion, social support, and health behavior were explored. Finally, taking exercise behavior, social cohesion, and social support as factors, the explanatory power of the older adults' health behavior was determined.

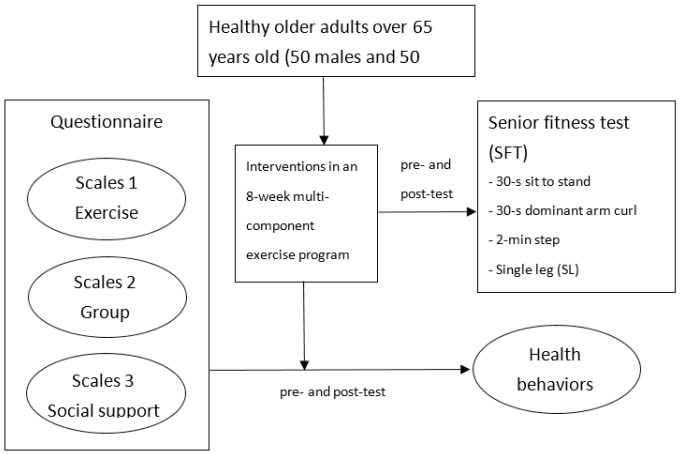

Figure 1: Research structure.

Research Participants

In this study, older adults in Taipei City were used as the population. Through the poster promotion of the physical fitness center of the college (including a QR code link to the registration information, online registration, and a printed registration brochure placed in the community service center), 100 healthy older adults aged over 65 were recruited (50 males and 50 females); according to the WHO, healthy older adults are defined as those with the ability to maintain normal life functions and general cognitive level [55]. The average age of males was 76.57 ± 1.46 years old, and the average age of females was 74.73 ± 1.68 years old. There was no significant difference between the two by t test ($t=-1.07$, $p<0.05$), indicating that although the participants were of different genders, the age groups were homogeneous. All studies included monitoring, testing, data collection, and report writing by three researchers from the beginning to the end. The whole event was free, and each participant received a sports bottle for taking part (due to the free sign-up, those who could not participate due to environ-mental, identity, or social and economic constraints were excluded). In terms of the efficacy of the sample, the participants implemented a multi-component exercise pro-gram for 8 weeks (a total of two months). Classes were scheduled from Monday to Friday, 2 hours a day, including walking, resistance training, yoga, on-site teaching, and monitoring; Saturdays and Sundays were managed by the participants themselves. In terms of sample

usage precision (using precision), the parameter mean differences (age) of the sample size were within the confidence interval, and the sample size was in line with the sample estimator for sports science research [56]. The recruited participants were first checked for personal background information, including gender, age, education level, marital status, smoking habits, drinking habits, and current living conditions (excluding those who were not affected by age, mental or physical conditions, or who were vulnerable to improper influence and coercion, or those who were unable to participate because of circumstances, status, or social and economic conditions, or those able to make decisions according to their own wishes). All participants in this study signed an informed consent form, which complied with scientific and ethical principles (contents included: no orthopedic disease or heart disease, no usual exercise program, and willingness to refrain from taking supplements that could in-crease muscle or sarcopenia during the study). This study was approved by the Jen-Ai Medical Foundation Dali Jen-Ai Hospital: Human Body Research Ethics Committee, approval number 110-96.

Research Materials

The interventions for the participants in this study were based on the Physical Activity Guidelines for Americans (PAGA) [57]; a multi-component exercise program (walking, resistance training, and yoga) was developed. Participants in this program experienced a total of 8 weeks [58-61]; an example of a one-week course is shown in Table 1. The type of exercise in the program was aerobic exercise, during which muscles used oxygen more efficiently and increased cardiac output [62,63]. The exercise intensity of the program was displayed in metabolic equivalent (MET). The MET is defined as the consumption of 3.5 milliliters of oxygen per kilogram of body weight per minute, which is roughly equivalent to a person sitting in a quiet state without any activity. An activity of 5 METs means that the consumption of oxygen per minute during exercise is 5 times that of rest [64]. This study implemented moderate exercise intensity, approximately 3.0-5.9 METs.

Week	Type	Content
Monday	Aerobic exercise	Walking (400-meter oval runway outside the school, at a speed of 6 km/hr, for 30 minutes).
Tuesday	Resistance training	1. Chair squats: 15 (times) x3 (set) Place a chair behind you, and start in a standing position; squat down and raise your hands horizontally, and then squat down and touch the chair with your buttocks and immediately rise into a standing position. Do this once. 2. Pistol squat: 10 (times) x3 (set) Stand on one foot and leave the other foot off the ground (you may hold a support), and perform 10 deep squats on the left and right feet. 3. Standing lunges: 20 (times) x3 (set) Start in a standing position with your feet together. Step forward with one foot (with a stride of more than 60 cm), retract the leg that has been stepped out, and step out with the other foot. Repeat the motion with your left and right feet 20 times. 4. Walk in place with high legs: 20 (times) x3 (set) Start in a standing position, raise your leg in place up to thigh-level, and repeat the operation with the left and right legs 20 times. 5. Dumb-bell arm curls: 12 (times) x3 (set) Stand vertically with dumb-bells in your hands; and abduct your hands to a horizontal level at the same time (females use a 6-pound dumb-bell; males use an 8-pound dumb-bell). 6. Dumb-bell flyers: 12 (times) x3 (set) Stand vertically with dumb-bells in your hands and abduct your hands to a horizontal level at the same time (females use 6-pound dumb-bell; males use 8-pound dumb-bell). 7. Dumb-bell shoulder raises: 12 (times) x3 (set) Hold the dumb-bells at shoulder height as the starting point, raise both hands vertically at the same time, and then return to the starting point (females use a 6-pound dumb-bell; males use an 8-pound dumb-bell). 8. Step-ups: 20 (times) x3 (set) 30 cm high steps; ascend the steps one foot at a time, stand with both feet together, then descend the steps one foot at a time, stand with both feet together, and repeat.
Wednesday	Aerobic exercise	Walking (400-meter oval runway outside the school, at a speed of 6km/h, for 30 minutes).
Thursday	Resistance training	Same as Tuesday.
Friday	Aerobic exercise	Yoga: Gentle yoga exercises can help older adults maintain flexibility and strength to prevent falls or fractures. Lung capacity is improved with yoga breathing exercises, and arthritis pain is reduced by gentle stretching.

Table 1: Multi-component exercise training program.

Detection Method

Based on the above purpose, we aimed to solve the following two questions: (1) Does the multi-component exercise program help older adults improve health behavior? (2) After the intervention, how does the exercise behavior, social cohesion, and social support of older adults predict health behavior? Additionally, we proposed the following hypotheses according to the research questions. **Hypothesis 1**: multi-component exercise program contributes to promoting healthy behaviors in older adults; **Hypothesis 2:** after the intervention, the exercise behavior, social cohesion, and social support of older adults can effectively predict the health behavior of older adults. Therefore, the following detection content was designed.

Older Adults' fitness test

We referred to the Senior Fitness Test (SFT) developed by Rikli and Jones [65], as showed in Table 2. The SFT test items are a 30 s sit-to-stand movement, 30 s dominant arm curl, 8-foot up-and-go (2.44 meters), 2 min step, and single leg (SL) exercises. This test is widely used to determine the physical fitness of older adults.

Test item	Test description
30 s sit-to-stand	Number of full stands completed in 30 s with arms folded across chest.
30 s dominant arm curl	Number of bicep curls completed in 30 s holding a hand weight (females used a 6-pound dumb-bell; males used an 8-pound dumb-bell).
2 min step	Number of full steps completed by raising each knee to a point midway between the patella and iliac crest (number of times the knee reaches the target) in 2 min.
Single leg (SL)	Participants had to lift one leg off the ground and maintain their balance while standing.
8-foot up-and-go	Number of seconds required to get up from a seated position, walk 8 feet (2.44 meters), turn around, and return to a seated position on the chair.
[1]Description of SFT items, from Rikli and Jones [65].	

Table 2: Brief description of the Senior Fitness Test.

Exercise Behavior, Social Cohesion, and Social Support Questionnaire for older adults

The Exercise Behavior, Social Cohesion, and Social Support Questionnaire for older adults (EBSCSS) is divided into three scales; the first is a physical activity scale for older adults adapted from Ku, et al. This Chinese version of the scale is a short and easy-to-score survey assessing physical activity (such as leisure time, housework, and occupational work) performed over a 1-week period [13]. This study focused on the physical activities of older adults during their leisure time; therefore, "leisure time physical activity" was identified to revise and increase the exercise intensity and exercise time. In total, 5 questions were revised and evaluated with a five-point Likert scale [66], named the Exercise Behavior Inventory for older adults, as shown in Table 3.

Number	Content and options
1	In the past 7 days, how many days have you been outdoors (exercise, walking, walking the dog, etc.)? (1) Never; (2) Rarely (1-2 days); (3) Sometimes (3-4 days); (4) Often (5-6 days); (5) Every day (7 days).
2	For how many hours do you exercise, walk, or walk your dog outdoors? (1) Less than 1 hour (2); More than 1 but less than 2 hours (3); More than 2 but less than 3 hours (4); More than 3 but less than 4 hours; (5) More than 4 hours.
3	In the past 7 days, how much moderately strenuous physical activity have you performed (the intensity of chatting, but not singing)? (1) Less than 60 minutes; (2) More than 60 minutes but less than 90 minutes; (3) More than 90 minutes but less than 120 minutes; (4) More than 120 minutes but less than 150 minutes; (5) More than 150 minutes.
4	In the past 7 days, how many steps have you walked on average each day? (1) Fewer than 2000 steps (2); More than 2000 but fewer than 4000 steps (3); More than 4000 but fewer than 6000 steps (4); More than 6000 but fewer than 8000 steps (5); More than 8000 steps.
5	What is your average walking rate? (1) Less than 40 steps per minute; (2) More than 40 but less than 60 steps per minute; (3) More than 60 but less than 80 steps per minute; (4) More than 80 but less than 100 steps per minute; (5) More than 100 steps per minute.

Table 3: Contents of the exercise behavior inventory for older adults.

Second: The Social Cohesion Scale for Older Adults was adapted from Paramita, et al.'s study on social cohesion [67]. The participants in this study were older adults; thus, it was revised as Social Cohesion of Older Adults. In total, 10 questions were revised to evaluate each item using a five-point Likert scale [66], named the Social Cohesion Scale for older adults. Third: The social support scale for older adults was adapted from the perceived social support scale for older adults developed by Nazari, et al. [68], with a total of 7 questions revised into a five-point Likert scale assessment [66], named the Social Support Scale for older adults.

This study revised the Exercise Behavior, Social Cohesion, and Social Support Questionnaire for Older Adults. In the completed first draft of the scale, a sample of 150 senior students (average age 74.35 ± 2.17 years) from the Taiwan College of Per-forming Arts was obtained for a pre-test. On-site assistance from the research team was required to complete the instructions. The results of the pre-test

retained all the items of the three scales after the project analysis, with 22 items and 3 factors in total. The reliability analysis of each factor was as follows: exercise behavior (5 items, explained variance of 26.85%, Cronbach's α=0.79), social cohesion (10 items, explained variance of 31.17%, Cronbach's α=0.83), social support (7 items, explained variance of 35.69%, Cronbach's α=0.86). The scale had good reliability, with a Cronbach's alpha coefficient between 0.79 and 0.86. Participants rated each item on a five-point Likert scale with response intervals as follows: 1 = strongly disagree; 2 = slightly disagree; 3 = slightly agree; 4 = agree; 5 = strongly agree [66]. A higher total score indicated a higher frequency of implementation of the Exercise Behavior, Social Cohesion, and Social Support Questionnaire of the Older Adults.

Health Behavior Inventory for the older adults

This study modified the Health Behavior Inventory developed by Awabil and Anane, and the Health Protective Behavior Scale developed by Ping et al., both of which are methods of measuring health behaviors [69,70]. The two scales were revised and completed with a total of 36 items in the first draft in order to meet the needs of male and female of older adults in this study; this was named the Health Behavior Inventory (HBI) for older adults. The first draft of the scale was completed, and 150 senior students (average age 69.27±3.61 years) of the Taiwan College of Performing Arts were sampled for a pre-test; the research team assisted on-site in the senior classroom of the Taiwan College of Performing Arts to explain the study aims. The results of the pre-test retained 36 items after project analysis, which were divided into 5 factors. The reliability analysis of each factor is as follows: healthy diet (8 items, explained variance of 20.43%, Cronbach's α = 0.83), medical and health care (8 items, explained variance of 17.37%, Cronbach's α = 0.81), emotion and stress (8 items, explained variance of 15.62%, Cronbach's α = 0.78), physical activity (7 items, explained variance of 25.19%, Cronbach's α = 0.87), smoking and drinking (5 items, explained variance of 13.35%, Cronbach's α = 0.71). The scale had good reliability, with a Cronbach's alpha coefficient of between 0.71 and 0.87. Participants rated each item on a five-point Likert scale with response intervals as follows: 1 = strongly disagree; 2 = slightly disagree; 3 = slightly agree; 4 = agree; 5 = strongly agree [66]. A higher total score indicated a higher frequency of implementing healthy behaviors.

Control Variable

This study only focused on healthy older adults over 65 years old. Gender and age were used as control variables in this study because these sociodemographic variables have been found to be related to health behaviors. A review of studies related to health behaviors showed that the gender and age of participants are variables that scholars need to control in research [71,72]. According to Selivanova and Cramm's research, health behaviors are significantly related to factors such as education level, marital status, smoking habits, drinking habits, and current living conditions [73]. In addition, before the experiment, the participants were educated about their diet and issued promotional health materials (including information on medical care, healthy diet, ways to relieve stress, the dangers of smoking and alcohol, and common sense of drug use), in order to reduce the interference during the experiment, which was the control variable in this study.

First, in order to confirm whether the sample size was sufficient, Cohen's d was used to determine the impact size of the t test [74]. Then, the size of Cohen's d effect was detected [75]. A Cohen's d value between 0.2 and 0.5 is a small effect; 0.5 to 0.8 is a medium effect; and a value higher than 0.8 is a large effect. The average age of males and females in this study had a small effect size, as shown by the Cohen's d value of 0.281. All participants performed descriptive statistical analysis of background variables (including gender, age, education level, marital status, smoking habits, drinking habits, and current living conditions). Questionnaire surveys (EBSCSS and HBI) were also conducted to obtain pre- and post-test values of the Standard Deviation (SD) and mean (mean) [76]. Statistical t-test analyses were performed for the 30 s sit-to-stand, 30 s dominant arm curl, 8-foot up-and-go (2.44 meters), 2 min step, and single leg (SL) exercises for both males and females; the overall significance level was set to $p<0.05$, and the relationships between the factors of the two scales were compared using the Pear-son product difference correlation. Analysis of variance among the three factors (F test) and Durbin-Waston test (the test value is distributed between 0-4, the closer to 2, the greater the possibility that the observed values are independent of each other) [77]. Finally, multiple regression analysis was employed to determine the explanatory power of exercise behavior, social cohesion, and social support on the health behavior of older adults. The data in this study were analyzed using the SPSS 20.0 software (IBM®, Armonk, NY, USA).

Results

Analysis of the Socio-Demographic Variables of Participants

The socio-demographic variables of the participants in this study-included gender, age, marital status, education level, smoking habits, drinking habits, and current living conditions, as shown in Table 4. Comparing males and females, there were no significant differences in mean age and marriage status. There was a significant difference in the education level between males and females. Most of the males were above high school level, whereas most of the females were at junior high school or primary school level. The smoking habits of males and females were significantly different, but among the current non-smokers and ex-smokers, 72% of males (50 of the older adults) and 96% of females (50 of

the older adults). There was a significant difference in the drinking habits of males and females, although 24% of males (50) and 78% of females (50) did not currently drink alcohol. The drinking habits of males and females were mostly concentrated at once per month: males reached 52% (50 of the older adults) and females reached 20% (50 of the older adults). Regarding the current living conditions of males and females, most males and females lived with their spouse, followed by their children. In addition, the difference between males and females living alone was the largest; the proportion of males was higher than that of females.

Variables	**Male (n = 50)**	**Female (n = 50)**	***t*-value**	***p*-value**
	$\bar{X} \pm$ **SD**	$\bar{X} \pm$ **SD**		
Age (years)	76.57 ± 1.46	74.73± 1.68	0.87	0.23
Marital status	**%**	**%**	***t*-value**	***p*-value**
Married	70	64	1.73	0.09
Unmarried	6	10	-1.56	0.12
Divorce	10	10	0.06	0.81
Widowed	14	16	-0.48	0.52
Education level	**%**	**%**	***t*-value**	***p*-value**
Primary school	8	26	-11.42*	0.00
Secondary	22	50	-16.37*	0.00
High school	54	20	14.85*	0.00
College and above	16	4	8.74*	0.00
Smoking habit	**%**	**%**	***t*-value**	***p*-value**
Smoking	20	4	1.37	0.14
No smoking	24	76	-9.13*	0.00
Quit smoking	48	20	6.52*	0.00
Occasional smoking	8	0	7.49*	0.00
Drinking habit	**%**	**%**	***t*-value**	***p*-value**
Every day	2	0	0.56	0.43
At least once per week	4	0	0.81	0.27
Up to once per week	6	0	4.23*	0.01
At least once per month	12	2	7.81*	0.00
Maximum once per month	52	20	17.35*	0.00
Do not drink	24	78	-23.64*	0.00
Current living conditions	**%**	**%**	***t*-value**	***p*-value**
Live alone	16	8	6.16*	0.00
Live with spouse	46	42	1.95	0.09
Living with spouse and children	22	28	-2.17	0.07
Live with children	16	22	-2.23	0.06

*$p < 0.05$; [1]Means ± standard deviations are presented as $\bar{X} \pm$ SD. t-test values are presented as *t*-values and p-values.

Table 4: The socio-demographic characteristics of the sample.

Descriptive Statistics of Pre- and Post-tests of the SFT

The multi-component exercise program lasted for 8 weeks; the t-values and percentage differences between pre- and post-tests of the SFT for all participants showed in Table 5. This showed that both males and females improved in all items of the SFT. The study also found that the multi-component exercise program could help improve the balance ability, upper and lower limb muscle strength of older adults. The results presented in the discussion.

Variables	Male (n=50)		Imp. (%)	*t*-value (*p*-value)	Female (n=50)		Imp. (%)	*t*-value (*p*-value)
	Pre-test	Post-test			Pre-test	Post-test		
A (times)	15.35 ± 2.43	20.42 ± 3.16	24.82	9.17*(0.0006)	13.12 ± 3.09	18.56 ± 2.87	29.31	12.36*(0.0001)
B (times)	22.54 ± 2.84	29.61 ± 2.59	23.88	8.85*(0.0008)	20.12 ± 2.75	26.42 ± 3.13	23.85	8.71*(0.0008)
C (times)	106.23 ± 7.42	121.87 ± 5.25	12.83	4.41*(0.004)	102.54 ± 6.92	118.63 ±6.55	13.56	5.25*(0.002)
D (s)	16.82 ± 6.19	20.98 ± 5.74	19.82	6.23*(0.001)	15.27 ± 7.02	19.25 ± 6.85	20.68	7.03*(0.0009)
E (s)	15.72 ± 5.23	19.55 ± 5.17	19.59	6.06*(0.001)	14.63 ± 6.02	17.31 ± 5.62	15.48	5.64*(0.001)
F (s)	6.19 ± 1.07	5.11 ± 0.81	17.45	5.49*(0.002)	6.29 ± 1.14	5.58 ± 0.86	11.29	4.79*(0.003)

*$p < 0.05$; [1]SFT: Developed in reference to Rikli and Jones's Senior Fitness Test (Rikli and Jones, 2013). The following are the detection codes of the SFT: A, 30 s sit-to-stand; B, 30 s dominant arm curl; C, 2 min step; D, single left leg stand; E, single right leg stand; F, 8-foot up-and-go. Pre- and post-test values are presented as means ± standard deviations ($\bar{X}$ ± SD). t-test values are presented as *t*-values (*p*-value). Imp. is an abbreviation of improvement.

Table 5: Descriptive statistics of pre- and post-tests of the SFT in older adults.

Analysis of Participants' Pre- and Post-tests in the EBSCSS

The pre- and post-test values of the EBSCSS for all participants are shown in Table 6. It was found that after following the multi-component exercise program for 8 weeks, there were significant differences between males and females in exercise behavior, social cohesion, and social support. High levels of agreement were identified in the findings. There were no significant differences in the pre- and post-test values for questions 10-14, 19, 20, and 22 for each question. However, the average values of the pre-test and post-test results for males and females were consistent, reaching an acceptable conclusion.

Factors and Items	Male (n=50)			Female (n=50)		
	Pre-test $\bar{X}$ ± SD	Post-test $\bar{X}$ ± SD	*t*-value (*p*-value)	Pre-test $\bar{X}$ ± SD	Post-test $\bar{X}$ ± SD	*t*-value (*p*-value)
Factor 1: Exercise Behavior	1.92 ± 0.21	4.05 ± 0.15	−13.61*(0.001)	1.65 ± 0.23	4.04 ± 0.16	−14.92*(0.001)
1. In the past 7 days, how many days have you been outdoors?	3.11 ± 0.19	4.52 ± 0.06	−9.52*(0.001)	2.37 ± 0.25	4.45 ± 0.08	−11.32*(0.001)
2. How many hours do you exercise, walk, or walk your dog outdoors?	1.24 ± 0.26	3.64 ± 0.17	−12.95*(0.001)	1.09 ± 0.17	3.46 ± 0.18	−15.06*(0.001)
3. In the past 7 days, how much moderately strenuous physical activity have you performed?	1.31 ± 0.24	3.26 ± 0.19	−10.61*(0.001)	1.05 ± 0.19	3.63 ± 0.16	−18.75*(0.001)
4. In the past 7 days, how many steps have you walked on average each day?	2.35 ± 0.27	4.73 ± 0.05	−14.47*(0.001)	2.27 ± 0.23	4.59 ± 0.07	−13.13*(0.001)
5. What is your average walking rate per minute?	1.58 ± 0.25	4.11 ± 0.08	−19.23*(0.001)	1.46 ± 0.21	4.05 ± 0.13	−16.65*(0.001)

Factor 2: Social Cohesion	3.79 ± 0.18	4.07 ± 0.09	−4.12*(0.009)	3.87 ± 0.15	4.05 ± 0.11	−3.71*(0.01)
6. Gain approval from neighbors in the community.	3.42 ± 0.22	4.11 ± 0.13	−5.17*(0.002)	3.84 ± 0.17	4.01 ± 0.13	−3.53*(0.02)
7. Gain approval from friends.	3.28 ± 0.25	4.05 ± 0.14	−5.35*(0.001)	3.22 ± 0.25	3.88 ± 0.17	−5.09*(0.003)
8. My friends evaluate me.	3.12 ± 0.27	3.88 ± 0.18	−5.26*(0.002)	3.64 ± 0.21	3.85 ± 0.19	−3.85*(0.01)
9. There are regular activity groups where I can make friends with many people.	3.78 ± 0.21	3.96 ± 0.17	−3.64*(0.01)	3.57 ± 0.23	4.02 ± 0.14	−4.83*(0.006)
10. I feel that the community is the center of my life.	4.07 ± 0.23	4.11 ± 0.12	−1.32 (0.17)	4.15 ± 0.09	4.18 ± 0.08	−1.25 (0.21)
11. I feel free from exclusion in the community.	3.83 ± 0.18	4.06 ± 0.13	−3.01 (0.06)	3.94 ± 0.17	4.05 ± 0.13	−2.88 (0.07)
12. I feel that my life has not changed much after retirement.	4.12 ± 0.12	4.17 ± 0.10	−1.58 (0.11)	4.07 ± 0.13	4.10 ± 0.12	−1.46 (0.15)
13. I feel that helping others is a very pleasant thing.	4.14 ± 0.11	4.17 ± 0.09	−1.29 (0.17)	4.08 ± 0.13	4.13 ± 0.10	−1.61 (0.10)
14. I welcome my relatives and friends marrying people from different ethnic groups.	4.10 ± 0.13	4.12 ± 0.11	−1.13 (0.27)	4.14 ± 0.10	4.16 ± 0.09	−1.18 (0.25)
15. I respect the many different cultures within the community (such as those with different religious beliefs or provincial/ national living habits).	4.01 ± 0.15	4.03 ± 0.14	−1.15 (0.26)	4.05 ± 0.12	4.08 ± 0.11	−1.31 (0.16)
Factor 3: Social Support	3.84 ± 0.19	4.02 ± 0.15	−3.45*(0.01)	4.01 ± 0.17	4.14 ± 0.08	−3.23*(0.03)
16. Feeling of having a place in the group.	3.77 ± 0.24	4.13 ± 0.10	−4.68*(0.005)	3.81 ± 0.19	4.04 ± 0.11	−3.85*(0.015)
17. Attending group activities with care and attention.	3.85 ± 0.17	4.17 ± 0.08	−4.36*(0.008)	3.92 ± 0.16	4.08 ± 0.10	−3.34*(0.02)
18. Be respected in groups.	3.69 ± 0.23	4.02 ± 0.16	−4.47*(0.007)	3.70 ± 0.21	4.01 ± 0.18	−4.29*(0.008)
19. To be accompanied by close people in life.	4.04 ± 0.12	4.05 ± 0.11	−0.18 (0.34)	4.13 ± 0.09	4.16 ± 0.08	−1.27 (0.18)
20. Usually participate in group activities (such as religious, charitable, or volunteering).	3.56 ± 0.27	3.61 ± 0.24	−1.51 (0.19)	4.11 ± 0.11	4.14 ± 0.08	−1.25 (0.22)
21. Often participate in activities in order to get close to people.	3.84 ± 0.19	3.98 ± 0.14	−3.29*(0.03)	4.24 ± 0.06	4.27 ± 0.05	−1.19 (0.27)
22. Always express gratitude to those close to you.	4.16 ± 0.08	4.18 ± 0.07	−0.52 (0.23)	4.07 ± 0.13	4.10 ± 0.10	−1.34 (0.13)

*$p < 0.05$; [1]EBSCSS is the abbreviation of the Exercise Behavior, Social Cohesion, and Social Support Questionnaire. Pre- and post-test values are presented as the means ± standard deviations ($\bar{X}$ ± SD). t- test values are presented as *t*-values (*p*-values).

Table 6: Pre- and post-test analyses of factors and items of the EBSCSS.

Analysis of Participants' Pre- and Post-test Values in the HBI

The pre- and post-test values of HBI for all participants in this study are shown in Table 7. It was found that after 8 weeks of the multi-component exercise program, most of the factors and items were significantly different; among them, females did not yield significant differences between pre- and post-tests of factor 5 and questions 18 to 20, indicating that female older adults had a fairly consistent response to avoiding tobacco, alcohol, and drug use; they all agreed very much. The factors of the HBI showed that the "regular physical activity" aspect had the largest difference between pre- and post-tests of males and females. Especially after 8 weeks of enacting the multi-component exercise program for female older adults, the 15th question (I exercise at least three days per week for more than 30 minutes each time) exhibited the largest difference between pre-test and post-test for all questions ($t=18.12^{*}$, $p<0.05$). The above results confirmed the acceptance of Hypothesis 1: a multi-component exercise program intervention could help the promotion of healthy behaviors in older adults.

Factors and Items	Male (n = 50)			Female (n = 50)		
	Pre-test $\bar{X} \pm SD$	Post-test $\bar{X} \pm SD$	*t*-value (*p*-value)	Pre-test $\bar{X} \pm SD$	Post-test $\bar{X} \pm SD$	*t*-value (*p*-value)
Factor 1: Healthy diet habits	3.25 ± 0.16	4.04 ± 0.11	−7.35*(0.0007)	3.91 ± 0.12	4.22 ± 0.07	−4.81*(0.003)
1. I control the amount of fat I eat.	3.32 ± 0.16	4.06 ± 0.12	−6.85*(0.0008)	3.81 ± 0.19	4.21 ± 0.08	−5.15*(0.001)
2. I control the amount of salt I eat.	3.27 ± 0.19	4.07 ± 0.11	−7.47*(0.0006)	3.84 ± 0.17	4.16 ± 0.09	−4.83*(0.004)
3. I avoid eating large amounts of sugar.	3.19 ± 0.21	4.11 ± 0.09	−8.09*(0.0004)	3.92 ± 0.13	4.29 ± 0.07	−4.96*(0.003)
4. I avoid chips and fried foods.	3.26 ± 0.18	3.84 ± 0.15	−5.81*(0.007)	3.94 ± 0.13	4.23 ± 0.08	−4.74*(0.004)
5. I control the amount of red meat I eat.	3.21 ± 0.20	4.13 ± 0.08	−8.13*(0.0004)	4.05 ± 0.11	4.18 ± 0.09	−2.27 (0.11)
Factor 2: Proper use of health care resources	3.20 ± 0.21	4.08 ± 0.10	−8.06*(0.0006)	3.47 ± 0.22	4.16 ± 0.09	−6.13*(0.003)
6. I take medicines according to the prescription.	3.37 ± 0.25	4.12 ± 0.09	−6.64*(0.0009)	3.68 ± 0.21	4.14 ± 0.10	−4.36*(0.008)
7. I attend all my scheduled health care appointments.	3.06 ± 0.34	3.95 ± 0.14	−7.93*(0.0005)	3.29 ± 0.33	4.05 ± 0.14	−6.88*(0.0008)
8. I have dental exams every year.	3.13 ± 0.31	3.98 ± 0.11	−7.65*(0.0006)	3.46 ± 0.27	4.06 ± 0.13	−5.85*(0.007)
9. I take prescription medication only as directed by a health care provider.	3.25 ± 0.27	4.11 ± 0.10	−7.82*(0.0005)	3.41 ± 0.31	4.32 ± 0.07	−8.11*(0.0004)
10. I take my blood pressure anytime.	3.19 ± 0.30	4.14 ± 0.09	−8.21*(0.0003)	3.55 ± 0.25	4.27 ± 0.08	−6.37*(0.001)
11. I ask a healthcare provider when I have unfamiliar physical symptoms.	3.21 ± 0.29	4.16 ± 0.07	−8.19*(0.0004)	3.43 ± 0.27	4.13 ± 0.10	−6.22*(0.002)
Factor 3: Avoid negative emotions, tension, and stress	3.31 ± 0.19	3.95 ± 0.11	−6.55*(0.002)	3.92 ± 0.12	4.15 ± 0.07	−3.79*(0.009)
12. I get irritated and mad when waiting in lines.	3.35 ± 0.18	3.97 ± 0.12	−6.15*(0.003)	3.81 ± 0.16	4.09 ± 0.09	−12.53*(0.0001)

13. I get angry and annoyed when I am caught in traffic.	3.29 ± 0.21	3.94 ± 0.13	−6.48*(0.001)	3.93 ± 0.13	4.12 ± 0.08	−3.38*(0.03)
14. Things build up inside me until I lose my temper.	3.27 ± 0.25	3.95 ± 0.13	−6.74*(0.001)	4.02 ± 0.10	4.23 ± 0.07	−3.56*(0.01)
Factor 4: Regular physical activity	3.05 ± 0.19	4.13 ± 0.07	−9.45*(0.0003)	2.55 ± 0.24	4.06 ± 0.08	−15.39*(0.0001)
15. I exercise at least three days per week for more than 30 minutes each time.	2.87 ± 0.31	4.12 ± 0.09	−12.17*(0.0001)	2.28 ± 0.29	4.05 ± 0.09	−18.12*(0.0001)
16. I often have a partner who exercises with me.	3.08 ± 0.29	4.11 ± 0.09	−8.96*(0.0002)	2.75 ± 0.18	4.02 ± 0.10	−12.61*(0.0001)
17. When I am free, I think about being outdoors or exercise.	3.21 ± 0.24	4.18 ± 0.07	−8.25*(0.0003)	2.63 ± 0.25	4.11 ± 0.08	−14.47*(0.0001)
Factor 5: Avoid tobacco, alcohol, and drug use	3.57 ± 0.21	4.02 ± 0.12	−6.75*(0.001)	4.17 ± 0.10	4.33 ± 0.07	−4.15*(0.005)
18. I do not smoke.	3.75 ± 0.22	3.95 ± 0.16	−4.16*(0.009)	4.31 ± 0.06	4.34 ± 0.06	−0.67 (0.43)
19. I do not use recreational drugs.	3.63 ± 0.25	4.08 ± 0.08	−6.83*(0.001)	3.94 ± 0.14	4.24 ± 0.08	−4.82*(0.007)
20. I do not use alcoholic beverages.	3.34 ± 0.28	4.02 ± 0.13	−9.79*(0.0002)	4.27 ± 0.07	4.42 ± 0.05	−1.59 (0.10)

*$p < 0.05$; [1] Pre- and post-test values are presented as means ± standard deviations ($\bar{X}$ ± SD). t-test values are presented as *t*-values (*p*-values).

Table 7: Pre- and post-test analyses of factors and items of the HBI.

Pearson Product-Moment Correlation Analysis of Various Post-test Factors between the EBSCSS and HBI

Each group in this study was on an equidistant scale; therefore, Pearson product-moment correlation analysis was used to assess post-test EBSCSS and HBI factors between males and females. Correlation analysis of post-test factors between the EBSCSS and HBI for males showed that the correlation coefficients were between 0.59 and 0.92, reaching a significant moderate or high correlation, as shown in Table 8. After 8 weeks of the multi-component exercise program, there was a positive medium–high correlation be-tween the EBSCSS and HBI. The correlation coefficient between the "exercise behavior" aspect of the EBSCSS and the "physical activity" aspect of the HBI was the highest, at 0.92 ($p<0.05$). The second highest correlation coefficient was between the "social sup-port" aspect of the EBSCSS and the "emotion and stress" aspect of the HBI: 0.91 ($p<0.05$).

	EBSCSS			
		Factor 1	**Factor 2**	**Factor 3**
		Exercise behavior	**Social cohesion**	**Social support**
HBI	**Factor 1: Healthy diet**	0.69*	0.63*	0.59*
	Factor 2: Medical and healthcare	0.78*	0.61*	0.76*
	Factor 3: Emotion and stress	0.76*	0.73*	0.91*
	Factor 4: Physical activity	0.92*	0.81*	0.83*
	Factor 5: Tobacco, alcohol, and drug use	0.65*	0.74*	0.71*

*$p < 0.05$

Table 8: Correlation analysis of various post-test factors between the EBSCSS and HBI in males.

In the post-test correlation analysis between EBSCSS and HBI factors for females, the correlation coefficient was between 0.51 and 0.88, reaching a significant moderate or high correlation, as shown in Table 9. After 8 weeks of the multi-component exercise program, there was a positive medium-high correlation between the EBSCSS and HBI. Among them, the correlation coefficient between the "exercise behavior" aspect of the EBSCSS and the "physical activity" aspect of the HBI was the highest, at 0.88 ($p<0.05$). The second highest correlation coefficient was between the "social support" aspect of the EBSCSS and the "medical and healthcare" aspect of the HBI: 0.87 ($p<0.05$).

		EBSCSS		
		Factor 1	**Factor 2**	**Factor 3**
		Exercise behavior	**Social cohesion**	**Social support**
HBI	**Factor 1: Healthy diet**	0.81*	0.58*	0.66*
	Factor 2: Medical and healthcare	0.83*	0.74*	0.87*
	Factor 3: Emotion and stress	0.79*	0.79*	0.73*
	Factor 4: Physical activity	0.88*	0.83*	0.86*
	Factor 5: Tobacco, alcohol, and drug use	0.51*	0.57*	0.55*
*$p< 0.05$				

Table 9: Correlation analysis of various post-test factors between the EBSCSS and HBI in females.

The Explanatory Power of EBSCSS on Health Behavior

After the Pearson product-moment correlation analysis was performed, it was found that there was a high correlation between the EBSCSS and HBI factors in male and female older adults; then, the EBSCSS factors were used for the explanatory power of the dependent variable (HBI). In the regression analysis, the statistical significance of the regression pattern was tested first. There were significant differences in the results of the F-test between the dependent and independent variables of males and females: male $F=87.354^*$ ($p<0.01$); female $F = 95.173^*$ ($p<0.01$), and the Durbin-Waston test value was 1.613. Male and female respectively showed that the data of the three factors were independent. Finally, multiple regression was used to analyze the explanatory power of the forced entry method (the independent variable considered in the regression model) to the health behavior of the dependent variable.

The male EBSCSS results could explain the HBI to a significant level; the explained variation was $R^2= 8.4\%$ ($p<0.01$). Among the independent variables, the estimated value of exercise behavior had the greatest impact on health behavior ($\beta=0.716$, $p<0.01$), followed by social support ($\beta=0.625$, $p<0.01$) and social cohesion ($\beta=0.598$, $p< 0.01$). The β-values of the three independent variables were all positive, indicating that the independent variables had a positive impact on the health behavior of male older adults, as shown in Table 10.

Variables	β	R	R^2	Adjusted R^2	p
Exercise behavior	0.716*	0.827	0.684	0.683	< 0.001
Social cohesion	0.598*				< 0.001
Social support	0.625*				< 0.001
[1] Independent variables: exercise behavior, social cohesion, and social support. Dependent variables: five factors of the HBI. *$p< 0.01$.					

Table 10: Multiple linear regression analysis of males.

The explanatory power of the female EBSCSS results to the HBI reached a significant level; the explained variation was R^2 = 78.7% ($p<0.01$). Among the independent variables, the estimated value of exercise behavior had the greatest impact on health behavior ($\beta = 0.743$, $p<0.01$), followed by social cohesion ($\beta = 0.697$, $p<0.01$) and social support ($\beta = 0.641$, $p<0.01$). The β-values of the three independent variables were all positive, indicating that the independent variables had a positive impact on the health behavior of female older adults, as shown in Table 11. Thus, Hypothesis 2 (exercise behavior, social cohesion, and social support after a multi-sport program intervention could effectively predict the health behavior of older adults) was validated and accepted.

Variables	β	R	R^2	Adjusted R^2	p
Exercise behavior	0.743*	0.887	0.787	0.786	< 0.001
Social cohesion	0.697*				< 0.001
Social support	0.641*				< 0.001

[1]Independent variables: exercise behavior, social cohesion, and social support. Dependent variables: five factors of the HBI. *p< 0.01.

Table 11: Multiple linear regression analysis of females.

Discussion

This study on socio-demographic variables in older adults found that there were significant differences between the educational level and health behaviors of males and females. According to Margolis's research, it was indicated that well-educated, re-tired older adults may practice healthier behaviors, especially when they face new chronic diseases and start to make healthy behavior changes [78]; many studies have also confirmed that the level of education is related to practicing healthy behaviors [79-82]. The smoking habits of males and females were significantly different, which was consistent with many prior studies [73,83-85]; moreover, the majority of older smokers were male [86]. In this study, among the older adults who were non-smokers and ex-smokers, 72% were male and 96% were female. This phenomenon showed that the proportion of older female smokers was less, and male older adults might quit smoking because they had chronic diseases [84]. Studies have found that 76% of males and 22% of females have drinking habits; most older adults in Taiwan who drink alcohol approximately once per month are defined as practicing light drinking [87]. The results showed that most older adults reduce their time engaging in social opportunities in shopping malls after retirement (Taiwanese drinking culture is also regarded as a kind of social interaction), and focus more on the impact of physical health and chronic diseases. The gradual reduction in alcohol intake was consistent with many studies [88-91]. The current living status of older adults was mostly "living with spouse", followed by "living with spouse or children". However, the proportion of older adults living alone in Taiwan has tended to increase (24.6% of the elderly population over the age of 85 live alone; 22.4% of those aged 75 to 84 live alone; and 21.9% of people aged 65 to 74 live alone) [92], as found in many previous studies [93-95]. Conversely, many studies have shown that older adults living alone today should not be considered socially isolated or lonely and that health behaviors are not affected if older adults receive socially compensatory resources (such as support from friends, neighbors, or health care services) [96-98].

This study intervened with a multi-component exercise program, and found that the performance of male and female older adults in "30 s dominant arm curl", "30 s sit to stand", "2 min step", and "8-foot up-and-go" exercises had significantly improved, indicating that after 8 weeks of intervention, the extremity strength of the upper and lower limbs had improved significantly. There were also significant improvements in "single left leg" and "single right leg" stands, showing improved balance in the older adults. These findings were consistent with those of many other studies [99-104], also showing that improved lower extremity strength leads to neurological integrity and reduces the risk of fall in older adults. In addition, from the perspective of older adults' adherence to exercise, after the implementation of the multi-component exercise pro-gram, it was found that the variety of exercises intrinsically motivated older adults to exercise, and the attendance rates of males and females reached 95% and 97%, respectively, demonstrating their exercise adherence [50,51]. The research team conducted exercise teaching and supervision, controlling the intensity of the exercise for the older adults when implementing the plan; thus, through group exercise, social support was engendered, such as increasing social opportunities and establishing mutual network communities. The fact that the exercise intervention virtually established adherence was a result, which was consistent with many studies [52,106-109].

After 8 weeks of the multi-component exercise program intervention for older adults, the Exercise Behavior, Social Cohesion, and Social Support (EBSCSS) questionnaire showed that there were significant differences between males and females' pre- and post-test values for each factor. In terms of exercise behavior, older adults exercised outdoors 5-6 days per week for 2-3 hours each time; engaged in 90-120 minutes of moderately

strenuous physical activity; and walked approximately 6000-8000 steps per day with an average walking rate of about 80 to 100 steps per minute, indicating moderate-intensity exercise. This result was in line with the WHO standard for physical activity in older adults [110]. In terms of social cohesion, older adults could increase their interactions with their neighbors by going outdoors, situate the community as central in their life, foster respect for the many different cultures in the community, gain the recognition of neighbors and friends, and have fixed groups (such as through religion and volunteer activities) to make many friends, and engage in volunteering to help others. This study showed that older adults develop their focus from community life, even if they live alone; they could also receive mental health benefits from community interactions, such as religious or volunteer activities. This result is consistent with many prior studies [34,35,55,111,112]. In terms of social support, the results showed that older adults receive care, attention, and respect when they participate in-group activities, increasing social networks and reducing social isolation [113]. This was consistent with Shen et al.'s study, who encouraged older adults to participate in social activities and build good interpersonal relationships [114]. The presence of loved ones (such as a spouse or children) with older adults plays an important role in maintaining good mental health [115]. Numerous studies have confirmed that older men receive more support from their wives and report greater satisfaction [116,117]; more-over, older women receive feelings of well-being when they receive support from children or friends [118].

The HBI test results indicated that the older adults had reduced their use of tobacco, alcohol, and drugs. This result has been confirmed by several other studies; the alcohol and tobacco use rates of older adults were lower than those of young people [119,120], because most older adults' perceived aging may be accompanied by chronic diseases; as such, the amount and frequency of alcohol consumption were both reduced [119]. In addition, the use of drugs by older adults has been prescribed by doc-tors [121,122], and most older adults are assisted by relatives or nurses when they see a doctor or take medication, ensuring that they can make good use of medical resources (Healthcare in Taiwan). Therefore, the "avoidance of tobacco, alcohol and drug use" and the "proper use of health care resources" in this study could be beneficial. In addition, it was worth paying attention to a "regular physical activity" and "healthy diet habit". The male and female older adults could exercise at least three days per week, for more than 30 minutes each time and mainly engaging in outdoor sports. This result was consistent with many prior studies [123-126]. Older adults could control the intake of fat, control the amount of salt, avoid eating a lot of sugar, eat no fried food, and control the amount of meat consumed in their diets. This result was consistent with many studies [127-131].

According to the correlation analysis of EBSCSS and HBI factors between males and females, it was shown that both males and females agreed that the correlation between exercise behavior (EBSCSS) and regular physical activity (HBI) was the high-est. Second, males rated "social support" (EBSCSS) as having the second highest correlation with "emotion and stress" (HBI). Females rated "social support" (EBSCSS) as having the second highest correlation with "medical and healthcare" (HBI). The multi-component exercise program intervention included a variety of exercise forms, which gave older adults a variety of different exercises to perform, each with different effects on the stimulation of body muscles. This exercise intervention had value. Evidence shows that physical activity has an impact on regular physical activity in older adults [132,133]. As for the relationship between social support, emotion, and stress, previous studies have shown that social support could lower blood pressure in older adults [134], and could enhance the ability to adapt to stress [135], which also showed that social support helps to relieve stress and reduce depression [136]. Social support is directly related to the medical care of older adults; community services could improve the physical and mental status of individuals and reduced the burden of care [137]. Asante et al.'s research confirmed that social support has a direct impact on older adults' health care [138]; for example, older adults regard the doctor-patient relation-ship as helpful and trustworthy, and as such, older adults may be more willing to accept treatment [139,140].

According to the results of the regression analysis, the EBSCSS could effectively explain the health behavior of older adults: in 68.4% of males (R^2=0.684) and 78.7% of females (R^2=0.787). For both male and female older adults, exercise behavior had the greatest explanatory power on the health behavior of older adults, followed by social support and social cohesion, which had high predictive power on the health behavior of older adults. The effectiveness of these three factors in predicting health behavior has been confirmed in many studies. Lindsay Smith, et al. studied the relationship between social support and exercise in older adults, and found that people with higher social support, especially from family members, were more likely to have exercise behavior [141]. Social cohesion reduced the chances of taking up smoking, with positive effects on health behaviors [142-144]. It was also found that the stronger the social cohesion (sense of security and trust) of the older adults, the more likely they were to engage in exercise together, thus promoting health [126,145,146].

From the results of the group joint exercise, the older adults showed an active preference for exercising with others of the same age, as well as improved exercise compliance [147]. Kim et al. examine the importance of neighborhood social cohesion in promoting healthy behaviors in older adults [36]. Table 11 show that the three factors in this study could effectively predict health behaviors, which was consistent with many other related studies [146,148-153].

Although the current study has revealed the predictive power of exercise behavior, social support, and social cohesion on health behaviors in older adults, several limitations remain. This study used healthy older adults as participants, all of whom all lived in urban areas. The results of the study cannot be extrapolated to older adults with chronic diseases, mild disabilities, or rural areas. This study was a point-to-point horizontal study, and only three factors, i.e., exercise behavior, social support, and social cohesion, were used as predictive independent variables. Healthy older adults in urban communities generally have good dietary behaviors and awareness of medical care; therefore, diet and medical care were included as control variables, and only diet and the level of health education were assessed regarding these two variables. Finally, the multi-component exercise program in this study was only designed for healthy older adults; thus, the physical activity patterns of disabled or chronically ill older adults must be re-evaluated, and suitable physical activity programs should be designed for specific groups of people. Therefore, the applicability and generalizability of this exercise program was limited.

Conclusions

In this study, specially assigned staff guided the 8-week multi-component exercise program for older adults; tested the physical fitness of the older adults; and con-ducted the EBSCSS and HBI questionnaires for all participants. The results found that the multi-component exercise program interventions helped the older adults to per-form 30 s sit-to-stand, 30 s dominant arm curl, 8-foot up-and-go (2.44 meters), 2 min step, and single leg exercises. The program helped to improve upper and lower extremity muscle strength and enhance balance, with the beneficial effect of preventing the risk of fall in older adults. Exercise interventions positively affect exercise behavior, social support, and social cohesion in older adults, with positive benefits on health behaviors. It has been suggested that the physical activity of older adults should be set at a moderate intensity, and group exercise should be adopted outdoors, so as to establish social networking opportunities, which are beneficial to mental health, and then to improve physical and mental health. In the future, a diverse group exercise program should be established for older adults with different physical and mental conditions to improve mental health and increase social participation, thereby improving the chances of successful and healthy aging.

Conflicts of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as potential conflicts of interest.

Institutional Review Board Statement

The study was conducted according to the guidelines of the Declaration of Helsinki and was approved by a local Institutional Review Board (protocol code 110-96).

Informed Consent Statement: Informed consent was obtained from all the participants in the study.

Data Availability Statement

The experimental results obtained real data about study participants pre- and post-tests. Participants agreed with the data collection procedure via an informed con-sent form; examples of the informed consent forms can be disclose upon reasonable request. All datasets on which the conclusions of the paper rely are available to editors, reviewers, and readers.

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Author Contributions

Conceptualization, W.K.C., H.H., and W.C.E.; resistance training program and methodology, W.K.C. and H.H.; software, W.C.E.; validation, W.K.C. and W.C.E.; formal analysis, W.K.C.; investigation, W.K.C.; resources H.H.; data curation, W.K.C. and W.C.E.; writing—original draft preparation, W.K.C.; writing-review and editing, H.H., W.K.C., and W.C.E.; supervision, W.K.C.; project administration, W.K.C. All authors have read and agreed to the published version of the manuscript.

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