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Home exercise program for post-coronary artery bypass surgery (CABG) at King Chulalongkorn Memorial Hospital : Effects on exercise performance and quality of life

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Objective : *To evaluate the effects of a home exercise program on exercise performance and quality of life (QOL) of post-CABG patients.*

Setting : *Department of Rehabilitation Medicine, King Chulalongkorn Memorial Hospital.*

Research design : *Prospective quasi-experimental study*

Subjects : *Thirty-five non-complicated post-CABG patients (18 males,17 females) from the Cardiothoracic Surgery Unit were enrolled into the study from August 1998 to April 1999.*

Methods : *The subjects were instructed for self monitoring of a 12-week home exercise program starting at 6 weeks post-operation, and were followed up every 3-4 weeks as needed. A submaximal leg ergometer test and SF-36 questionnaires were used to evaluate exercise responses and QOL before and at the end of the the program. Paired and unpaired t-tests were used to compare the results where appropriate.*

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Results : *Twenty eight of 35 subjects (80 %) finished full program. The average resting HR decreased 6.8 bpm, submaximal exercise HR decreased 7.7 bpm, the RPP (HR x systolic BP x 10^{-2}) decreased 15.0, and SF-36 scores increased 23.7 %; all were significantly different from before exercise rates at $P \leq 0.001$. Blood pressure and body weight were not significantly changed. Female subjects aged $\geq$ 65 years had lower QOL scores than the other group.*

Conclusions : *The self-monitoring home exercise program is effective in improving physical functions, myocardial oxygen consumption, and QOL with low cost and has good adherence for post-CABG patients.*

Key words : *Cardiac rehabilitation, Coronary bypass surgery, Quality of life, Exercise training.*

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ดุจใจ ชัยวานิชศิริ, ธนกรณ์ งามเชวง. โปรแกรมออกกำลังกายที่บ้านสำหรับผู้ป่วยหลังผ่าตัดหลอดเลือดหัวใจของโรงพยาบาลจุฬาลงกรณ์ : ผลต่อสมรรถภาพทางกายและคุณภาพชีวิต. จุฬาลงกรณ์เวชสาร 2543 มี.ค; 44(3): 163 - 75

วัตถุประสงค์ : *เพื่อประเมินผลของโปรแกรมออกกำลังกายที่บ้านต่อสมรรถภาพทางกายและคุณภาพชีวิตของผู้ป่วยหลังผ่าตัดหลอดเลือดหัวใจ*

สถานที่ทำการศึกษา : *ฝ่ายเวชศาสตร์ฟื้นฟู โรงพยาบาลจุฬาลงกรณ์*

รูปแบบการวิจัย : *การวิจัยกึ่งทดลอง ชนิดศึกษาไปข้างหน้า*

ผู้ป่วยที่ได้รับการศึกษา : *ผู้ป่วยที่ได้รับการผ่าตัดหลอดเลือดหัวใจโดยไม่มีภาวะแทรกซ้อนจากหน่วยศัลยกรรมทรวงอก โรงพยาบาลจุฬาลงกรณ์ ในช่วงเดือนสิงหาคม 2541 ถึงเดือนเมษายน 2542 จำนวน 35 คน เป็นชาย 18 คน หญิง 17 คน*

วิธีการศึกษา-วัดผล : *สอนให้ผู้ป่วยออกกำลังกายเองที่บ้านเป็นเวลา 12 สัปดาห์ โดยเริ่มตั้งแต่ 6 สัปดาห์หลังผ่าตัด ให้บันทึกการออกกำลังกายและมาติดตามผลทุก 3 - 4 สัปดาห์ ใช้การทดสอบออกกำลังกายแบบต่ำกว่าสูงสุดด้วยจักรยานอยู่กับที่เป็นเครื่องประเมินสภาพร่างกาย ใช้แบบสอบถาม SF-36 เป็นเครื่องมือวัดคุณภาพชีวิตที่ก่อนและหลังจากเข้าโปรแกรมเปรียบเทียบผลที่ได้ด้วย paired t-test และ unpaired t-test ตามความเหมาะสม*

ผลการศึกษา : *ผู้ป่วยทุกรายออกกำลังกายได้ตามที่กำหนด 27 ใน 35 คน (80 %) มาตามนัดทุกครั้ง ค่าเฉลี่ยอัตราเต้นหัวใจขณะพักลดลง 6.8 ครั้ง/นาที อัตราเต้นหัวใจขณะออกกำลังลดลง 7.7 ครั้ง/นาที RPP (อัตราเต้นหัวใจ x ความดันซีสโตลิก $x10^{-2}$) ขณะออกกำลังลดลง 15.0 คะแนน คุณภาพชีวิตเพิ่มขึ้นเฉลี่ย 23.7% การเปลี่ยนแปลงดังกล่าวมีนัยสำคัญทางสถิติที่ $P \leq 0.001$ ส่วนความดันโลหิต และน้ำหนักตัวไม่เปลี่ยนแปลงจากก่อนเข้าโปรแกรม ผู้ป่วยหญิงที่อายุมากกว่า 65 ปี มีคะแนนคุณภาพชีวิตต่ำกว่ากลุ่มอื่น*

สรุป : *โปรแกรมออกกำลังกายที่บ้านสำหรับผู้ป่วยหลังผ่าตัดหลอดเลือดหัวใจมีผลดีในการเพิ่มสมรรถภาพทางกาย เพิ่มประสิทธิภาพการใช้ออกซิเจนของหัวใจ เพิ่มคุณภาพชีวิตอีกทั้งมีความสะดวก ประหยัด และทำตามได้ง่าย*

คำสำคัญ : *การฟื้นฟูหัวใจ, การผ่าตัดหลอดเลือดหัวใจ, คุณภาพชีวิต, การออกกำลังกาย*

Cardiac rehabilitation has been accepted as a useful medical intervention for various types of cardiac disorders especially coronary artery disease.[1] Meta-analyses have shown an approximate 25% reduction of fatal recurrent rates, 15-25 % improvement in exercise capacity,[1-3] and later studies showed significantly increased quality of life after the program.[4-7] Traditionally, cardiac rehabilitation consists of risk factors modification and exercise program. The exercise program is mainly an aerobic type and usually starts within 3-4 weeks post-discharge. It is constructed as an out-patient service with moderate intensity (70-85% maximum HR), 3 times per week for 8-12 weeks duration. During exercise sessions, blood pressure, heart rate, and ECG changes are monitored for maintaining exercise intensity and for safety.[8-9] Recent studies showed benefits of light aerobic exercise without ECG monitoring, with more adherence rates, lower costs, similar quality of life outcome, but slightly slower and less aerobic capacity gained.[10-17]

In Thailand, cardiac rehabilitation units have been established in several hospitals in the last decade, but relatively low percentages of the patients who need rehabilitation were available to attend the programs. The home exercise program seems to be suitable as an alternative way of improving physical and cardiac functions for low to moderate risk patients.

This study was to evaluate the effects of a light aerobic home exercise program on patients who underwent coronary artery bypass grafting (CABG) for exercise adaptations and quality of life.

Subjects

Coronary artery disease patients who underwent CABG surgery at the Cardiothoracic Surgery Unit of King Chulalongkorn Memorial Hospital from August 1998 to April 1999 were recruited into the study. Patients who had complications or contraindications for exercise according to the American College of Sports Medicine's criteria 1991,[8] or could not be followed up were excluded.

All subjects had received routine pre- and post-operative rehabilitation services, including breathing exercises, range of motion exercises, and ambulation training. Before being discharged they had also been instructed to take their own pulse rate and to control their risk factors.

Methods

Subjects were inducted in the out-patient department of the Rehabilitation Medicine Clinic. The 12 weeks home-based exercise program was introduced at 6 weeks after surgery. It consisted of 5 minutes warm up, 15-40 minutes walking or cycling, and a 5 minute cool down period with 1-2 sessions per day, 5-7 days per week. The exercise intensity was determined by setting a target heart rate at 20 to 25 beats above the resting heart rate (approximate to 60-70% HRmax) and/or using Borg's rate of perceived exertion scale 11 to 13 (fairly light to somewhat hard) of a total 15 categories (scale 6 to 20).[18] Subjects were instructed to exercise and to record their resting pulse rate, exercise pulse rate, and exercise duration at least 5 days per week and were followed up every 3-4 weeks to assess their progression and were provided counselling. Subjects who could not follow the instructions and those with less than 80% attendance were defined as drop outs.

Before and after the program, a submaximal leg ergometer test[19] was performed to evaluate the

physical performance of each subject. A Monark model 818E was used at 50 rpm with 25 watt increments for every 2 minute-stage. Lead II ECG, and blood pressure were monitored and recorded during the tests. Hemodynamic parameters representing exercise responses were described in mean $\pm$ SD. The body weight, resting HR, exercise HR, blood pressure, and rate-pressure product (RPP = HR x systolic BP x 10^{-2}) before and after the exercise program were compared. Effects of β - blockers used were analysed.

The quality of life was measured by using a short form 36 (SF-36) health questionnaire [20] (Thai version) before surgery, before the exercise program, and at the end of the program (Figure 1). The short form 36 questionnaire has been used to measure health related QOL in different populations.[20,21] The American Association of Cardiopulmonary Rehabilitation (AACVPR) 1995 had recommened SF-36 for QOL assessment of cardiac patients,[22] and the Cardiac Rehabilitation Society of Thailand (CARES-THAI) introduced this questionnaire for Thai patients in 1998. The questionnaire consists of 36 items which measure eight dimensions: physical function (10 items), social function (2 items), role limitations due to physical functions (4 items), role limitations due to mental conditions (3 items), mental health (5 items), energy/vitality (4 items), pain (2 items), and general health perception (5 items). One item asking about health change is unscored. The outcome scores were calculated into percent, described in mean $\pm$ SD, and compared between before and after the exercise program. Results of different age groups and gender were compared.

For statistical analyses, the paired t-test and unpaired t-test were used to compare the results. The appropriateness of these methods was checked by visual inspection of histograms and normal probability plots. Statistical significance was accepted at $P<0.01$, 95% confidence interval. The analyses were performed utilizing SPSS for Windows version 9.0.

Results

Thirty five subjects (18 males, 17 females) were enrolled into the study. All subjects completed the exercise program and the SF-36 health questionnaire. Thirty two of the 35 subjects underwent the submaximal exercise testing before entry into the program, the other three could not ride the ergometer. At the end of the program, 25 subjects performed

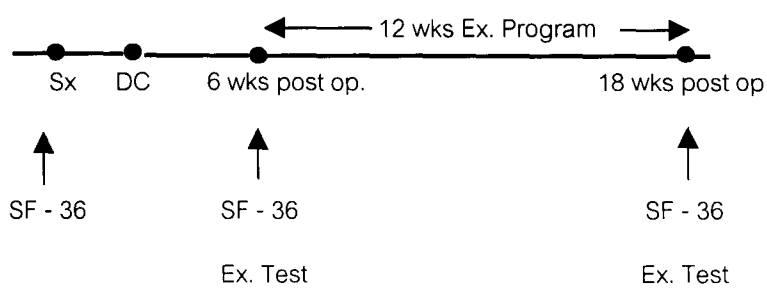

Figure 1. Study design.

post- program testing, 7 subjects did not come to the test due to socioeconomic and transportation problems, 1 subject reduced his β-blocker dosage during training, so 24 subjects (15 males, 9 females), remained to be analyzed the pre and post-program exercise responses.

During exercise training, 25 subjects monitored the exercise intensity by taking their own pulse rate, and others used Borg's rate of perceived exertion (RPE). All subjects preferred walking as their exercise mode, while two males and one female added stationary cycling to their sessions. Most subjects exercised 5 or more days per week.

The baseline data of the subjects is shown in table 1; the males mean age was lower than females without statistical significance, and about half of the subject's ages over 65. The body mass indexes were within normal range, and the QOL scores before surgery were lower in females (46.2 vs 54.8).

At the end of the program, the resting HR reduced 6.8 ± 5.2 bpm, the submaximal exercise HR reduced 7.7 ±9.3 bpm, and the submaximal RPP reduced 15.0±19 from before exercise, which are significant at $P \leq 0.001$ (Table 2, Figure 2). The body weight and blood pressure were not significantly changed. Subjects who used β-blockers had lower

Table 1. Baseline datas of the subjects. (mean ± SD)

	Total	Male	Female
N	35	18	17
Age	61.5 (9.7)	58.8 (10.3)	64.4 (8.4)
Age ≥ 65	18	7	11
Age < 65	17	11	6
BMI	24.0 (3.7)	24.5 (2.8)	23.5 (4.5)
QOL score before Sx (%)	48.3 (19.1)	56.0 (20.4)	40.1 (14.0)

Table 2. Hemodynamic measures (n = 24) and body weight (n = 28) at before an after exercise program. (mean ± SD)

	Before	After	Difference	P - value
HR rest	76.9 (14.8)	70.0 (11.3)	6.8 (5.2)	0.00
HR exercise	92.1 (19.9)	84.4 (15.0)	7.7 (9.3)	0.00
BP systolic	136.1 (16.9)	133.2 (17.7)	2.9 (10.9)	0.20
BP diastolic	80.4 (9.6)	78.6 (8.2)	1.7 (9.4)	0.36
BP exercise	146.6 (18.3)	141.7 (19.2)	4.9 (15.0)	0.12
RPP ($x10^{-2}$)	134.9 (32.8)	119.9 (27.9)	15.0 (19.7)	0.00
BW (kg)	59.7 (12.8)	60.2 (11.2)	- 0.5 (1.3)	0.04

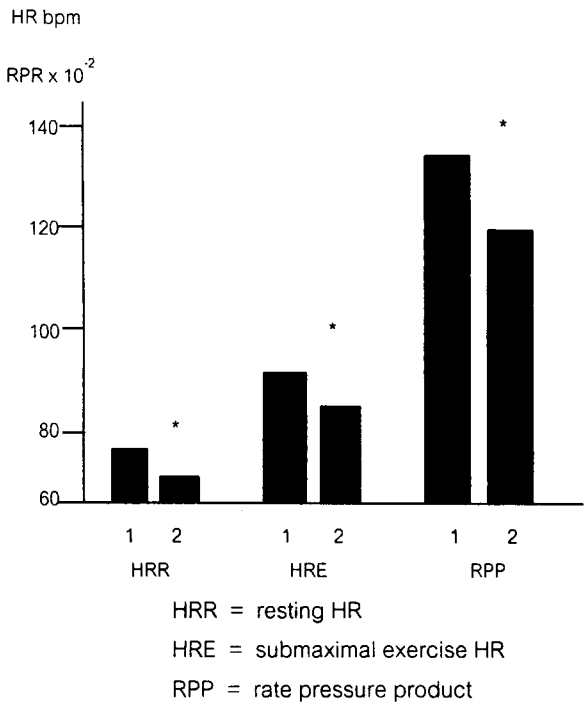

Figure 2. Means of hemodynamic parameters at before (1) and after (2) the home exercise program.
* significant at P < .001.

HR and RPP than non- β- blocker users, but the degree of improvement after the exercise program were not different (Table 3).

SF-36 scores were significantly increased after exercise; 22.4% in males and 25.0% in females. Males gained higher scores than females (77 vs 71) without significant difference (Table 4, Figure 3.1). Subjects aged over 65 had lower SF-36 scores than the lower age group (68 vs 80, Table 5, Figure 3.2), and sex did not influence the scores within groups (Table 6). Subjects with ejection fractions (EF) below 0.35 gained SF-36 scores as high as subjects with higher EF (Figure 3.3).

Fig. 3.1

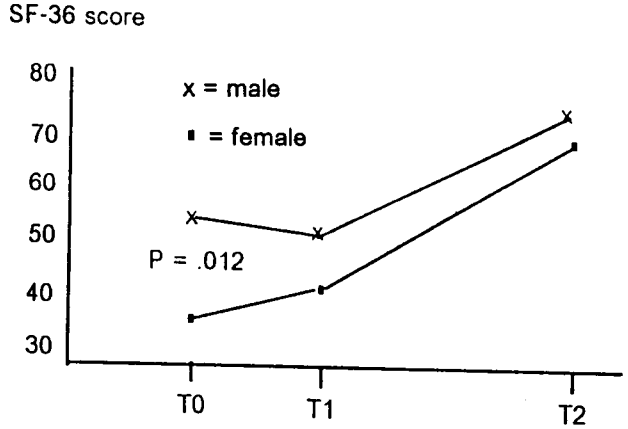

Fig. 3.2

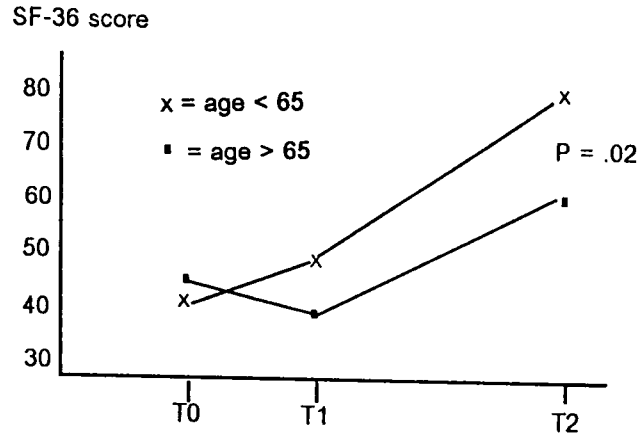

Fig. 3.3

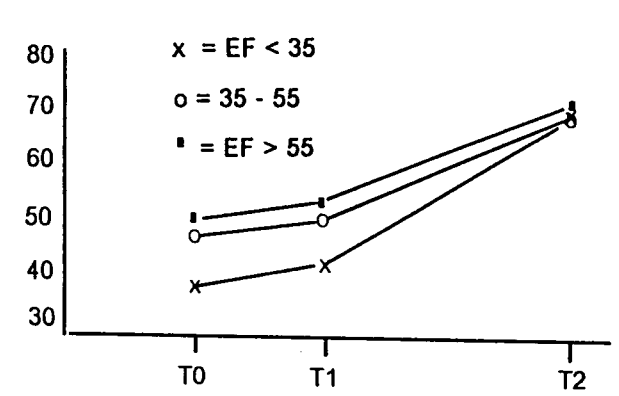

Figure 3. Mean SF-36 scores (%) in sequence time.
T0 = preoperative T1 = before exercise (6 wks. post operation)
T2 = after exercise (18 wks.post operation)

Table 3. Hemodynamic measures (mean ± SD) in subjects using and not using β - blocker.

	β - blocker (n = 11)	No β- blocker (n = 13)	Difference	P - value
HR rest	63.4 (8.0)	75.6 (10.8)	12.1 (9.0)	0.00
HR exercise	75.1 (6.4)	92.2 (15.9)	17.0 (11.2)	0.00
RPP	103.4 (17.9)	133.8 (27.6)	30.3 (12.5)	0.00
Δ HRR before - after	6.2 (1.2)	7.3 (1.7)	-1.1 (2.1)	0.61
Δ HRE before - after	7.5 (3.1)	7.8 (2.4)	- 0.3 (3.9)	0.90
Δ RPP before - after	19.6 (22.0)	11.0 (17.4)	8.6 (25.3)	0.29

Table 4. The SF- 36 scores (mean ± SD) at before and after exercise program calculated into percent.

	Before	After	Difference	P - value
Total	50.6 (16.3)	74.3 (14.7)	23.7 (15.8)	0.00
Male (n = 18)	54.8 (18.6)	77.2 (14.0)	22.4 (14.6)	0.00
Female (n = 17)	46.2 (12.4)	71.2 (15.1)	25.0 (17.4)	0.00

Table 5. The SF-36 scores (mean ± SD) of subjects age above and below 65.

	≥ 65 (n = 18)	< 65 (n = 17)	P - value
Before	46.7 (12.3)	54.7 (19.2)	0.85
After	68.8 (14.2)	80.2 (13.2)	0.02
Difference	22.0 (14.2)	25.4 (17.7)	0.74

Table 6. The SF- 36 scores (mean ± SD) of males and females in different age groups.

	Before	After	Different
Age ≥ 65 male (n = 7)	44.6 (8.4)	70.0 (13.0)	25.3 (7.1)
female (n = 11)	48.1 (14.6)	68.0 (15.5)	19.9 (17.3)
Age < 65 male (n = 11)	61.3 (20.7)	81.9 (13.1)	20.5 (17.9)
female (n = 6)	42.6 (6.9)	77.0 (13.9)	34.4 (14.3)

Discussion

There have been continuing studies on the effectiveness of many aspects of cardiac rehabilitation programs. From the 1970s, the studies mainly emphasized mortality and recurrence rates. In later years, the studies extensively focused on risk factors modification, exercise performance, return to work, psychological status, and quality of life. Different types of exercise components were tested and compared; high-low intensity,[12-14,16] aerobic-resistive exercise, continuous-interval training, hospital-home based programs,[11] etc. This study aimed at the low risk post-CABG patients which previously reported gain benefits from cardiac rehabilitation programs including: modifying risk factors;[23,24] reduction of resting and exercise HR, BP, and RPP;[24-26] increasing functional capacity approximately 10-28% of VO_2 max;[11,25-27] promote psychological status;[7,27] and improve QOL.[7,28,29]

To prescribe exercise for specific purposes, the exercise components must be appropriate to stress the body adaptations. The essential exercise components for aerobic exercise are: dynamic type, intensity above 50% HRmax, 20 minutes duration, and frequency at least 3 times/week. If the intensity is low, more time is recommended.[15] In this study, we used the exercise records as a tool to make sure that the subjects follow the instructions properly. Self-monitoring and recording also helped the patients increase their confidence and motivation. Most of the subjects relaxed and enjoyed the exercise, resulting in good adherence. If the seven patients who did not show up for the test at the end of the program were defined as drop outs, the adherence rate was 80% (28 of 35).

The results of the submaximal exercise testing showed significant improvements of hemodynamic responses indicating physical performance (reduction of resting and exercise HR) and myocardial function (reduction of submaximal exercise RPP) without adverse events. These benefits are comparable with the study of Froelicher V, et al [26] in 1985. Their randomized trial of the effects of 80% HRmax exercise intensity, 3 times/week after CABG resulted in 5.8 bpm and 11 bpm declines of resting and exercise heart rate.

Analysis of subjects using and not using β-blockers demonstrated equal degrees of improvement (before-after), while those who used β-blockers had lower HR and RPP during exercise. These findings agreed with the studies of Laslett LJ in 1983 [30] and Steven R in 1984.[11]

The blood pressures and body weights were not significantly changed which could possible be due to inadequate exercise intensity and/or duration, combined with some adverse alterations in lipoprotein metabolism following β-blocker administration, and with increasing appetite after anxiety reduction.

Maines TY, et al (1997)[6] analyzed the effects of 12 weeks of outpatient cardiac rehabilitation for coronary artery disease (MI, CABG, PTCA) using 75-85% HRmax intensity. The results showed 33% improvement in functional capacity, and overall 14% gains of QOL scores. Lavie CJ, and Milani RV (1996)[31] reported 20% gains in QOL scores in coronary patients aged ≥ 75. They also studied the cardiac rehabilitation program effects on elderly women [32] and obese coronary patients [33] and reported 16% and 14% gains of QOL scores respectively.

Age and gender are important factors which

influence the QOL scores. Studies[34,35] reported that coronary disease women have lower QOL in areas of physical function and psychosocial aspects; they usually age older than men and have more problems in arthritis, transportation, anxiety and depression. Our study found that women's QOL scores were lower than men's before surgery. They then rose up to nonsignificant difference levels at 6 weeks post-operation before starting the program. During the exercise program, the QOL scores rapidly increased about 23%, which is higher than previously reported. These outcomes may be influenced by the less strict home program (less anxiety), combined with the lower QOL scores at the starting point, and the differences in race, culture, and life style of the subjects.

When subjects in different age groups were compared (Table 5,6), the subjects aged $\geq$ 65 had lower QOL scores at the end of the program but without gender differences. Despite equal QOL, women aged over 65 gained less improvement than men (19% vs 25%). We also found that EF did not influence the QOL outcome, corresponding with the report of Sjoland H, et al in 1998.[36]

The presented outcomes resulted from exercise effects and CABG surgery. Further research should be done with a control group to isolate the effects of exercise programs from spontaneous recovery after surgery. Also, the QOL in sexual aspects along with sleep disturbance which were reported as common problems after CABG[37,38] but not included in the SF-36 questionnaire, should be evaluated.

Conclusions

Self-monitoring home exercise programs for post-CABG patients is effective in improving hemodynamic responses during exercise which reflex physical and myocardial functions, and with favourable QOL gained. This simple program is low risk, low cost, motivative and has good adherence. However, more attention should be focused on geriatric populations, especially elderly women.

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