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Effects of Continuous Passive Motion, Walking, and a Placebo Intervention on Physical and Psychological Well-Being

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To investigate claims that continuous passive motion tables improve physiological and psychological well-being, 94 healthy women were assigned randomly to 12-week programs involving a placebo-control meeting, unsupervised walking, continuous passive motion, and continuous passive motion plus diet. Program outcomes were assessed by analysis of pre- and post-treatment fasting blood chemistry, a graded, symptom-limited maximal exercise test, anthropometric measurements of skinfold and circumferences, and flexibility, as well as anxiety, depression, mood, and somatic distress. Significant improvements were found in cholesterol, weight, suprailiac and weighted skinfold, arm circumference, hip flexibility, and exercise endurance in the active groups. Women in the continuous passive motion plus diet condition had a significant weight loss and improved lipid profile. Committed walkers significantly outperformed women in the continuous passive motion groups on cardiovascular fitness but were more likely to terminate participation in the program prematurely. Results suggested that involvement in continuous passive motion generates positive expectancies for improved physical and psychological well-being, which may improve adherence to health-promoting regimens.

INTRODUCTION

Consistent involvement in aerobic exercise has been repeatedly associated with multiple health and cardiovascular benefits,[1,2] alleviation of occupational stress,[3] and reductions in chronic psychological dysphoria.[4] Demographic statistics indicate that 59% of the adult population engages in some form of exercise, with 32% involved for at least three hours a week; 11% describe themselves as committed runners.[5] Despite the enormous popularity of exercise activities, researchers have failed to elucidate specific physiological mechanisms that could account for the ameliorative stress-reduction properties of exercise. Previous investigations[6] suggest that aerobic activities derive their palliative psychological effects from nonspecific expectancy influences that also are found in many alternative leisure pursuits.

Physically demanding aerobic exercise also has been associated with a growing number of hazards,[7] including delayed menarche,[8] shinsplints and tendinitis, stress fractures, knee and back injuries,[9] sudden death, and, in rare circumstances, acute aortic dissection.[7,10,11] Estimates[12,13] indicate that between 45% and 65% of the almost 20 million runners in the United States injured each year are hurt seriously enough to require them to stop running for some period of time.

Innovative modalities of exercise promotion and stress reductions have been developed in recent years. One increasingly popular innovation is the continu-

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ous passive motion (CPM) table. CPM tables are "motorized machines that continuously move isolated muscle groups through their range of motion without requiring any effort by the user."[14] Originally developed to aid the rehabilitation of victims of polio and assorted orthopedic injuries, CPM tables have become a widely used supplement for regular physical exercise and could become a possible substitute for aerobic activities. Proponents of these machines assert that regular use will increase flexibility, reduce girth (by toning muscles), and reduce stress. These claims have generated considerable controversy[14] but have yet to be subjected to rigorous empirical scrutiny. The purpose of this investigation was to evaluate the possible physiological and psychological benefits produced by continuous passive motion exercise.

METHODS

Characteristics of Program Participants. A total of 94 healthy, middle-aged women initially were recruited from the local community. Participation was limited to women who were not dieting or engaged in any sort of systematic physical fitness program. Complete sets of pre- and post-treatment psychological and physiological data were obtained from 69 of the 94 participants, yielding an overall completion rate of 74%. The 69 women who completed the program ranged from 28 to 64 years ($\bar{x} = 42.9 \pm 7.4$ years) and weighed from 56.8 Kg to 115.5 Kg ($\bar{x} = 75.9 \pm 13.3$ Kg). Although the women were somewhat overweight, their mean physiological data were within normal limits for the following variables: resting heart rate ($\bar{x} = 72 \pm 9.2$ beats/min), resting blood pressure ($\bar{x} = 122/81 \pm 14.2/9.0$ mmHg.), glucose ($\bar{x} = 98 \pm 12.2$ $mg \cdot dl^{-1}$), cholesterol ($\bar{x} = 211 \pm 40.4$ $mg \cdot dl^{-1}$), high density lipids ($\bar{x} = 60 \pm 12.8$ $mg \cdot dl^{-1}$) and triglycerides ($\bar{x} = 100 \pm 42.9$ $mg \cdot dl^{-1}$).

Data Collection Strategies and Instruments. Following guidelines proposed by Hughes,[15] participants were randomly assigned to four discrete 12-week health-improvement programs. Contentions concerning the viability of CPM were evaluated through repeated assessment of blood chemistry, resting physiological data and cardiovascular functioning, body composition, flexibility, and psychological well-being. These data were collected one week before the respective interventions and within two days after program termination. All participants provided their informed consent before completing any assessment procedures. Pretreatment data included early morning fasting blood chemistry, resting heart rate, and blood pressure. A graded, symptom-limited maximal exercise test, using a standard Bruce protocol, also was completed. Heart rate and blood pressure were recorded during the last minute of each three-minute stage, at maximal exercise, and again; at one minute and three minutes during recovery.

Skinfold measures (mm) were taken with the Holtain caliper on the right side of the body and included triceps, suprailiac, abdomen, thigh, and calf.[16] The average of three trials not differing by more than 10% was recorded. Flexibility (degrees) was evaluated using the Leighton Flexometer, with the average of two trials not differing by more than 10% being used as the criterion score. The measurements included shoulder extension/flexion, hip extension/flexion, trunk lateral flexion, and hip adduction/abduction. All circumference measurements (cm) were taken with a steel tape and included upper arm, waist, thigh, and calf. The average of two trials not differing by more than 10% served as the criterion.

Psychological well-being was assessed through use of the State-Trait Anxiety Inventory[17] and the Beck Depression Inventory.[18] These widely used trait instruments were augmented by sampling state ratings of positive and negative moods and somatic distress over four-day periods at the beginning and the end of the program. Mood states were evaluated along four positive dimensions (alert, energetic, involved, and content) and four negative dimensions (depressed, frustrated, apathetic, and preoccupied). Ratings were made along six-point Likert scales were zero (0) indicated "no experience" of the mood and six (6) indicated "extremely strong experience."

Somatic distress assessed ten areas of functioning (general tension, heart/chest pains, gastrointestinal difficulties, joint/tendon stiffness, circulatory problems, headaches, backaches, muscular soreness/stiffness, respiratory difficulties, and lethargy or general fatigue). Somatic distress also was rated along six-point Likert dimensions where zero (0) meant "no distress" and six (6) meant "almost unbearable distress." Johnson[19] reported Cronbach alpha coefficients of .9165, .8599, and .6375 for positive mood, negative mood, and somatic distress, indicating that each global scale had acceptable internal consistency. Single-item estimates also were obtained of estimated length of sleep to the nearest one-quarter hour and overall sleep quality (along a six-point scale). Following Zuckerman,[20,21] these state ratings were averaged to yield values that closely approximate those obtained from one-shot trait assessments.

Content and Format of Treatment Interventions. The women were randomly assigned to one of four interventions: (1) a group meeting-control condition that served as a placebo intervention (Placebo Meeting); (2) committed walking with gradually increasing distances (Walking); (3) continuous passive motion (CPM) exercise; and (4) continuous passive motion combined with dieting (CPM + Diet). To increase statistical power of the most theoretically relevant comparisons, approximately twice the number of participants were randomly assigned to the three exercise groups than to the control condition. The meeting-control, walking, CPM, and combined CPM + Diet groups began with 12, 28, 25, and 29 women, respectively. Seventy-one of these women completed their various regimens, and data were collected from a total of 69, with 11, 15, 20, and 23 members of the respective groups providing both pre- and post-treatment data.

Meeting-Control Condition. Women who were assigned to the meeting-control condition met once weekly during the 12-week program. The 60-minute sessions were used to discuss general issues related to wellness and how participants might better reduce life stress by engaging in self-nurturant activities. The average attendance rate was 78%. Over the course of the program, the group listened to a 60-minute relaxation tape, a 90-minute video tape on laughter, and lectures on basic exercise physiology, premenstrual distress, menopause, and yeast infections. They also had a demonstration on body movement and self-expression.

The format of these group meetings was to engage the women in a general discussion of stress management to be followed by having each participant make a commitment to engage in some self-nurturant activity on a regular basis two times a week. In each subsequent meeting, the success of the women in meeting the goals each had established during the prior session was assessed, and suggestions were provided for overcoming obstacles to implementing the desired activity. The group was led by a cardiovascular rehabilitation nurse with expertise in group dynamics, wellness, fitness, and relaxation techniques.

This condition permitted assessment of any improvement in psychological and physiological well-being as a result of general or "nonspecific" factors such as a commitment to undertaking a self-improvement regimen, time and effort devoted to such an undertaking, and support and encouragement by peers and an authoritative other. Such "placebo control" groups have been shown to be powerful in promoting positive physiological and psychological benefits.[22–24] A validity check of the nonspecific nature of this intervention was provided by asking participants if they had engaged systematically in either exercising or dieting as their self-nurturant project. All of the respondents indicated that they had not engaged in either activity.

Graduated Walking. Walking generally is considered among the most beneficial of exercises.[25] Women assigned to the walking group made a commitment to walk three times a week for the 12-week program. The first month required walking at a gradually increasing distance, progressing from .25 miles the first week, through .50 the second, .75 during the third, and 1 mile during the fourth week. During the second month, the women walked two miles per session, and increased to three miles during the final four weeks. This group provided an aerobic activity condition against which the short-term psychological and physiological effects of continuous passive motion exercise could be compared.

Continuous Passive Motion. Women in the continuous passive motion group exercised a total of 60 minutes per session three times a week. Each participant spent ten minutes on six different tables. CPM tables are motorized devices that continuously move isolated muscle groups through a range of motion with occasional resistive activity. The tables provide assisted movement of a prone flutter kick, supine midriff rocking, circular leg motions, sit-ups and vibration.[14] The women were instructed to tighten their abdominal and gluteal muscles during individual exercises.

Combined Continuous Passive Motion and Diet. An innovative weight-control program was used in conjunction with the CPM equipment for the fourth experimental group. For 12 weeks, the group met once a week for 90 minutes. Participants were not given any specific diet. Instead, each was supplied with a kit of innovative "right brain" nutritional tools and taught how to design her own personalized weight-control program. The kit contained a self-monitored nutrition system along with a 1,200-calorie-per-day regimen. Instructions included provision of information about monitoring fluid intake, creating low-fat, high-fiber meals, and using positive affirmations to better manage stress.

Statistical Analysis. Several statistical strategies were used to evaluate the differential effectiveness of the four treatment conditions. The first examined the 35 variables in multiple Group X Time (4×2) analyses of variance. As noted in Tables I through IV, these analyses reveal significant ($P < 0.05$) main effects for Time on 22 of 33 variables, with all 22 indicating significant improvement subsequent to participation. These findings suggest that simply getting involved in

TABLE I

MEANS AND STANDARD DEVIATIONS OF BLOOD CHEMISTRY AND RESTING PHYSIOLOGICAL INDICES COLLECTED BEFORE AND AFTER PARTICIPATION IN THE FOUR INTERVENTIONS

VARIABLE	GROUP			
	PLACEBO MEETING	WALKING	CPM ONLY	CPM + DIET
Glucose (mg/dl^{-1})‡	104.0 ± 19.5	92.3 ± 7.0	98.2 ± 11.5	98.2 ± 10.0
	97.3 ± 12.1	87.7 ± 8.8	91.6 ± 12.9	90.9 ± 9.1
Cholesterol‡	223.6 ± 46.4*	187.2 ± 17.5	214.3 ± 44.0	216.8 ± 41.1†
(mg/dl^{-1})	200.9 ± 31.9	165.5 ± 16.3	181.5 ± 30.2	171.0 ± 34.9
High Density	56.5 ± 12.6	62.5 ± 16.5	55.5 ± 12.1	63.0 ± 9.7
Lipids (mg/dl^{-1})	58.8 ± 11.8	65.8 ± 15.1	57.4 ± 13.0	62.5 ± 13.3
Triglycerides‡	127.5 ± 44.7	73.6 ± 19.0	108.9 ± 53.7	95.4 ± 32.8
(mg/dl^{-1})	103.5 ± 40.0	65.8 ± 20.6	89.5 ± 46.9	82.3 ± 36.7
Weight (Kg)	78.9 ± 10.6*	75.7 ± 17.1	77.0 ± 15.0	74.0 ± 10.4†
	79.2 ± 10.6	74.7 ± 17.3	76.4 ± 14.6	70.0 ± 10.6
Resting Heart‡	68.5 ± 7.2	80.5 ± 11.6	73.5 ± 8.9	73.1 ± 5.9
Rate (beats/min)	61.8 ± 18.4	72.8 ± 6.4	72.8 ± 9.6	68.4 ± 8.9
Resting Systolic	119.3 ± 17.6	119.1 ± 14.4	126.1 ± 13.6	121.3 ± 12.6
Blood Pressure (mmHg)	125.6 ± 12.0	121.9 ± 16.6	120.3 ± 15.1	120.4 ± 14.5
Resting Diastolic	79.1 ± 9.2	79.5 ± 9.9	83.6 ± 8.2	81.0 ± 9.0
Blood Pressure (mmHg)	82.0 ± 11.6	80.5 ± 10.2	83.6 ± 9.9	78.1 ± 8.2

*Significant contrast, $P < 0.05$, between meeting vs three other treatments.
†Significant contrast, $P < 0.05$, between CPM alone vs CPM + Diet.
‡Significant, $P < 0.05$, main effect of time for entire sample.

any sort of self-improvement activity yielded physical and emotional benefits. Failure to find a consistent pattern of significant Group × Time interactions, however, suggested that improvement was not consistently significant as a result of involvement in any particular treatment intervention.

A more precise and sophisticated analysis involved comparing the four groups by means of multiple analyses of covariance, using the pretreatment score as the covariate for the post-treatment score. This overall analysis was followed by four planned statistical comparisons that examined differences between: a) the meeting-control condition versus the three exercise groups, b) the walking group versus the two continuous passive motion groups, c) continuous passive motion alone versus walking, and d) continuous passive motion alone versus CPM plus diet. The first, second, and fourth comparisons are statistically independent and, thus, evaluate nonoverlapping sources of variance. The third comparison is not statistically independent of the others but was computed because of its theoretical importance.

RESULTS

Table I presents descriptive statistics of blood chemistry and resting physiological data for each group before and after the program and results of planned contrasts. Significant contrasts were found with respect to cholesterol and weight. The first contrast indicated that members of three active groups (i.e., walking, CPM, and CPM plus dieting) manifested significantly greater cholesterol and weight reduction than did members of the meeting-control group. Dieting plus CPM, however, was more effective in reducing cholesterol and weight than was CPM alone. Walking was not significantly different than either CPM group on any variable. In conjunction, these findings suggest that the dieting component is the active ingredient in reducing weight and cholesterol.

Table II describes performance data obtained during and immediately following a standard Bruce treadmill test. Time to volitional exhaustion indicates that active participants significantly outperformed meeting-control participants (1.2 minutes on the average vs .2 minutes, respectively). Significant post-treatment differences in peak heart rate were found between the walking group and the two passive machine groups. In addition, walkers manifested significant heart rate differences relative to both passive motion groups, when measured at peak performances and at one and three minutes of recovery.

Table III describes anthropometric and flexibility data before and after intervention. Participants in the

TABLE II
MEANS AND STANDARD DEVIATIONS OF BRUCE TREADMILL PROTOCOL AND RECOVERY COLLECTED BEFORE AND AFTER PARTICIPATION IN THE CONTROL, WALKING, PASSIVE MOTION, AND COMBINED TREATMENT GROUPS

	GROUP			
VARIABLE	PLACEBO MEETING	WALKING	CPM Only	CPM + Diet
Bruce Protocol				
Minutes to¶				
Volutional	6.8 ± 2.6*	8.3 ± 2.0	7.0 ± 2.6	8.2 ± 2.4
Exhaustion	7.0 ± 1.7	9.1 ± 2.5	8.2 ± 2.0	9.7 ± 2.3
Heart Rate at¶	121.0 ± 15.2	121.5 ± 15.5	123.3 ± 22.5	127.4 ± 18.8
three minutes (beats/min)	121.5 ± 15.5	114.8 ± 15.3	120.1 ± 22.2	118.9 ± 17.7
Maximal Heart	149.8 ± 13.5	163.0 ± 14.3†	155.5 ± 18.0‡	165.8 ± 11.0
Rate (beats/min)	151.2 ± 13.3	157.6 ± 17.5	159.6 ± 21.6	171.0 ± 9.3
Recovery				
Heart Rate (beats/min)	100.3 ± 15.9	107.4 ± 20.5†	106.0 ± 16.9	106.6 ± 15.2§
one minute	101.3 ± 9.1	103.8 ± 17.0	98.9 ± 20.1	111.5 ± 15.6
Heart Rate (beats/min)	90.0 ± 15.8	101.1 ± 19.9†	92.2 ± 11.6†	92.8 ± 9.4
(three minutes)	89.3 ± 15.6	82.7 ± 15.2	95.0 ± 12.5	96.9 ± 13.5

*Significant contrast, $P < 0.05$, between meeting vs three other treatments.
†Significant contrast, $P < 0.05$, between Walking vs CPM alone and CPM + Diet.
‡Significant contrast, $P < 0.05$, between Walking vs CPM alone.
§Significant contrast, $P < 0.05$, between CPM alone vs CPM + Diet.
¶Significant, $P < 0.05$, main effect of time for entire sample.

three exercise groups showed significant improvement over meeting-control participants on 5 of 15 comparisons; suprailiac skinfold, weighted skinfold, arm circumference, hip flexion/extension, and hip abduction/adduction. Changes in these skinfold measures were most strongly associated with membership in the combined CPM + diet group. There were no anthropometric or flexibility differences between walkers and members of the CPM alone group.

Table IV presents self-reported traits of anxiety and depression, daily sleep time, quality of sleep, and summaries of somatic distress, positive mood, and negative mood averaged over four-day periods. Ratings made across the ten areas of somatic functioning were summed to yield a global assessment of daily somatic distress. Specific positive and dysphoric mood items were similarly summarized to yield global indices of positive and negative affect, respectively. These data augment the physiological assessments to attest to the generally healthy nature of the entire sample. The means also indicate that involvement with any form of self-improvement activity is associated with decreased anxiety and depression as well as a lessening of dysphoric mood. Statistically significant differential effects, however, were found only between women in the two CPM groups. Dieting plus CPM resulted in significantly greater decrements in negative effect than use of CPM alone. No differences were found between women involved in the CPM regimen and walkers.

DISCUSSION

At a general level, the efficacy of the entire self-help program was supported. The entire sample manifested statistically significant reductions in serum glucose and cholesterol levels, triglycerides, resting heart rate, weight, and associated skinfold and circumference, anxiety, depression, somatic distress, and negative effect, as well as improved time to volitional exhaustion. This general improvement, however, represents an aggregated outcome of specific effects that were differentially associated with membership in particular interventions. More specifically, 8 of 26 contrasts significantly favored the performance of women in the three exercise groups against members of the discussion-control condition. These contrasts indicated that exercise reduced cholesterol levels, weight, suprailiac skinfold, weighted skinfold, and arm circumference and improved hip flexibility and treadmill performance relative to the meeting-control group. These effects did not extend to psychological well-being, however, as none of the seven relevant contrasts were significant.

The relatively greater improvements in cholesterol, weight, skinfold, and circumference were most

TABLE III
MEANS AND STANDARD DEVIATIONS OF ANTHROPOMETRIC AND FLEXIBILITY DATA COLLECTED AT PRETREATMENT AND POSTTREATMENT FOR PARTICIPANTS BY TREATMENT GROUP

VARIABLE	Group: PLACEBO MEETING	WALKING	CPM ONLY	CPM + DIET
Triceps§	32.5 ± 8.9	27.8 ± 9.8	29.4 ± 8.6	30.5 ± 8.6‡
Skinfold (mm)	32.4 ± 10.7	27.9 ± 10.7	28.6 ± 7.1	26.6 ± 9.3
Abdominal§	35.1 ± 7.9	33.2 ± 11.0	36.2 ± 7.2	34.2 ± 6.8‡
Skinfold (mm)	34.1 ± 5.9	30.0 ± 10.9	34.1 ± 7.5	29.4 ± 8.2
Calf Skinfold§	33.8 ± 6.2	28.6 ± 10.7	29.1 ± 7.7	27.0 ± 5.9
(mm)	33.0 ± 7.5	27.2 ± 10.6	26.4 ± 5.8	23.4 ± 7.9
Suprailiac§	28.6 ± 9.7*	29.5 ± 11.6	34.5 ± 6.9	30.8 ± 8.9
Skinfold (mm)	27.6 ± 10.5	22.7 ± 12.1	28.1 ± 8.8	22.2 ± 9.1
Weighted Total§	33.8 ± 6.7	31.2 ± 10.1	32.8 ± 6.7	31.3 ± 5.9‡
Skinfold (mm)	33.3 ± 7.5	28.1 ± 10.7	30.0 ± 6.4	26.4 ± 6.9
Circumference§	38.1 ± 3.0	37.8 ± 4.2	37.7 ± 3.2	37.3 ± 3.5
of Calf (cm)	36.7 ± 5.2	36.9 ± 3.6	37.0 ± 3.1	36.0 ± 3.4
Circumference	60.0 ± 3.4	59.2 ± 7.1	57.8 ± 5.0	58.8 ± 6.1
of Thigh (cm)	60.0 ± 4.0	59.2 ± 7.1	58.2 ± 6.8	56.9 ± 6.7

*Significant contrast, $P < 0.05$, between meeting vs three other treatments.
†Significant contrast, $P < 0.05$, between Walking vs CPM alone and CPM + Diet.
‡Significant contrast, $P < 0.05$, between CPM alone vs CPM + Diet.
§Significant, $P < 0.05$, main effect of time for entire sample.

TABLE III CONTD

VARIABLE	GROUP: PLACEBO MEETING	WALKING	CPM ONLY	CPM + DIET
Circumference†	89.7 ± 9.1	82.3 ± 14.4	86.9 ± 12.4	81.7 ± 8.7
of Waist (cm)	86.6 ± 8.5	79.2 ± 12.8	82.9 ± 11.9	76.4 ± 7.9
Circumference†	33.0 ± 2.5*	30.7 ± 4.4	31.2 ± 3.5	30.8 ± 2.5
of Arm (cm)	32.8 ± 2.7	29.6 ± 4.0	30.3 ± 3.1	29.6 ± 2.9
Shoulder	196.1 ± 13.8	199.8 ± 19.4	199.9 ± 19.3	198.0 ± 24.7
Flexibility (deg)	194.1 ± 12.3	199.8 ± 20.2	190.1 ± 24.0	192.0 ± 20.5
Hip Flexion	124.6 ± 20.9*	132.1 ± 18.6	134.1 ± 18.9	131.5 ± 18.6
Extension (deg)	117.2 ± 17.5	130.9 ± 20.4	137.4 ± 16.2	135.4 ± 16.1
Hip Abduction†	46.7 ± 8.0*	48.5 ± 9.5	49.8 ± 10.6	45.9 ± 9.8
Adduction (deg)	41.2 ± 5.0	45.8 ± 7.5	48.1 ± 7.8	46.6 ± 8.5
Trunk†	64.5 ± 6.9	61.9 ± 17.6	60.3 ± 13.4	59.1 ± 13.7
Laterality (degrees)	49.7 ± 7.0	51.5 ± 12.2	55.6 ± 14.4	55.0 ± 11.6

*Significant contrast, $P < 0.05$, between meeting three other treatments.
†Significant, $P < 0.05$, main effect of time for entire sample.

notable among women who followed a dietary regimen, suggesting that diet was the essential ingredient in improving cholesterol and weight-related measures. This contention is bolstered by the finding of significant contrasts favoring women in the CPM + Diet group over the CPM alone group on cholesterol levels, body weight, and skinfold measures. Women who dieted and used CPM also manifested significant reductions in trait anxiety, depression, and somatic distress relative to women who only used the machines.

Of particular importance was the finding that CPM was not substantially different than a regimen of walking, with the important exception of cardio-

TABLE IV

MEANS AND STANDARD DEVIATIONS OF SELF-REPORTED ANXIETY, DEPRESSION, SLEEP QUALITY, SOMATIC DISTRESS AND MOOD DATA COLLECTED AT PRETREATMENT AND POSTTREATMENT

	GROUP			
VARIABLE	PLACEBO MEETING	WALKING	CPM ONLY	CPM + DIET
Trait†	38.6 ± 9.9	35.1 ± 9.1	39.5 ± 8.3	37.4 ± 9.5*
Anxiety	36.5 ± 8.2	32.9 ± 7.3	39.3 ± 8.5	33.1 ± 9.9
Trait† Depression	6.4 ± 3.4	3.1 ± 4.5	4.6 ± 3.2	3.5 ± 3.3*
	4.4 ± 2.9	2.1 ± 2.7	4.0 ± 4.1	1.7 ± 2.0
Hours of Sleep	7.2 ± 0.7	7.1 ± 1.3	7.6 ± 0.9	7.2 ± 0.8
	6.9 ± 1.3	7.3 ± 1.1	7.5 ± 0.9	7.2 ± 0.6
Quality of Sleep†	3.9 ± 0.5	4.0 ± 0.7	4.2 ± 0.7	4.2 ± 0.8
	3.2 ± 1.1	3.5 ± 0.8	3.3 ± 0.6	3.7 ± 0.7
Somatic Distress†	4.4 ± 4.3	3.7 ± 3.2	3.3 ± 2.2	3.4 ± 2.5*
	3.7 ± 4.5	2.5 ± 2.7	3.4 ± 3.0	1.6 ± 1.1
Positive Affect	10.0 ± 3.0	11.1 ± 4.2	11.2 ± 3.4	10.4 ± 3.4
	10.6 ± 4.2	11.7 ± 4.1	10.1 ± 4.2	11.1 ± 4.0
Negative Affect†	3.2 ± 2.6	3.2 ± 3.6	3.9 ± 3.0	3.7 ± 2.8
	2.8 ± 3.4	1.2 ± 1.9	2.5 ± 2.5	2.1 ± 1.9

*Significant contrast, $P < 0.05$, between CPM alone vs CPM + Diet.
†Significant, $P < 0.05$, main effect of time for entire sample.

vascular conditioning. When compared with CPM, walking did not produce differential improvements in resting blood chemistry or physiological variables, weight and related anthropometric measures, flexibility, or psychological well-being. It may be that consistent use of the CPM tables may not be as totally "passive" as critics suggest, especially if participants comply with instructions to systematically tighten various muscle groups.

Treadmill performance data indicated that walkers and women who used CPM exercised for an equivalent amount of time, although walkers manifested significantly more robust cardiovascular responses, as described by peak and recovery heart rates. The recovery data suggest a probable cardiovascular conditioning effect favoring walking over continuous passive motion.

In summary, our data support the efficacy of CPM with adjunctive self-help activities such as dieting. Improved performance over time by the women who followed the CPM regimen relative to control participants implicate positive and negative expectancies.[22–24] The operation of these "halo" influences can best be seen in the treadmill data.

At post-treatment assessment, members of the meeting-control group appear to have been manifesting "resentful demoralization."[26] Their endurance time suggests that they were not especially motivated to improve performance, perhaps as a result of being involved in a less glamorous program than the CPM regimen. In contrast, women in the two CPM groups seem to have been positively motivated to work harder at the physiological tasks as a way of demonstrating that their involvement had been beneficial. Dieters appeared to be especially prone to provide such evidence of efficacy and were aided in doing so by their weight loss. The stress of enduring longer treadmill exertion for women in the combined CPM plus diet intervention was reflected by the fact that their average peak heart rate was close to the theoretical maximal heart rate for 42-year-old women. The recovery rate at both one and three minutes also was substantially slower for these women, as would be expected after such extraordinary effort. Walkers demonstrated the highest level of cardiovascular fitness post-treatment but also appeared less motivated to demonstrate maximal performance on the treadmill than passive exercisers.

The substantially elevated dropout rate of walkers relative to women in the CPM groups also is congruent with this expectancy interpretation. Exercise dropouts tend to be heavier, more likely to smoke, and manifest higher levels of cholesterol and less aerobic capacity.[27,28] These individuals often show little enthusiasm for routine aerobic activities, citing inconvenience as the major reason for failing to take advantage of even highly accessible programs.[29] CPM interventions may have an attractive allure that, in combination with the generation of positive expectancies,[23,24] might attract those at higher risk for cardiovascular dysfunctions. The tenacity of the women who exercised passively and dieted is especially noteworthy, given that their regimen was extremely demanding. The social facilitation provided by continuous passive motion may make it a safe and valuable adjunct to available weight-control programs. The allure of such devices may assist in motivating greater initiation of and compliance with traditional health-maintenance programs, especially for selected populations (e.g., hypertensive, arthritic, status post-CVA) for whom dynamic aerobic exercise may be inappropriate or contraindicated.

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