

Influence of a Trans-Theoretical Model Based Intervention on Physical Activity in Hypertensive Patients: A Randomised Clinical Trial

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Abstract

Background: Although physical activity is necessary, but not performed by most hypertensive individuals. One of the most common theoretical frameworks used for understanding health behaviour change is the trans-theoretical model.

Objectives: This study was conducted to evaluate the effect of a trans-theoretical model based intervention on physical activity in hypertensive patients.

Methods: We conducted a randomized clinical trial among 60 hypertensive patients (31 experimental and 29 control). Participants in experimental group received a fast walking intervention based on a trans-theoretical model. Physical activity stages of change, processes of change, frequency, duration and intensity of walking were measured at the onset, 3 and 6 months post-intervention. The data was analyzed using SPSS 22 software.

Results: At 3 and 6 months post-intervention a significant difference was observed between the experimental and control groups for physical activity stages of change, processes of change, duration and intensity of walking ($P < 0.05$). Also at 3 months post-intervention a significant difference was observed between the experimental and control groups for frequency of walking ($P < 0.05$).

Conclusions: This study suggests that trans-theoretical model based intervention in hypertensive patients play important roles in an individual's commitment to participate in physical activity.

Keywords: Trans-Theoretical Model, Education, Physical Activity, Hypertension

1. Background

Nearly a billion people worldwide have high blood pressure (BP) and this number is anticipated to reach 1.56 billion by 2025 (1, 2). According to the seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high BP (JNC7), adoption of a healthy lifestyle is an inevitable part of the management of people with hypertension (HTN) and one component of this is regular aerobic physical activity (PA) such as fast walking (at least 30 minutes most days of the week) (3). One recent study found that only 14.1% of hypertensive patients engage in regular PA (4).

In reports on walking interventions, little attention has been given to the underlying theoretical basis of the program being tested (5). The lack of a theoretical basis in such interventions may lead to low commitment due to a lack of insight into the psychological difficulties of adopting the program (6). Theories that can identify the main factors that influence behavior and the relationships between these factors are useful in identifying the components upon which intervention should focus (7). One of

the most common theoretical frameworks used for understanding health behaviour change is the trans-theoretical model (TTM) (8) which indicates that individuals engaging in a new behavior move through a series of stages of change (9). These stages include: pre-contemplation (inactive, no intention), contemplation (inactive and 6-month intention), preparation (irregularly active and intention), action (regularly active for less than 6 months) and maintenance (regularly active for more than 6 months) (10, 11). Processes of change are strategies that people use to progress through stages. There are five cognitive and five behavioural processes (12).

Studies that have tested the effectiveness of the TTM on exercise behaviour change in individuals with HTN have considered the construct of stages of change and self-efficacy rather than the processes of change (9, 13, 14). Chiang (2009) studied hypertensive persons based on stages of change and showed that a walking program had no significant effect on walking endurance (9). In an educational intervention by Bosworth (2008) in hypertensive patients for the purpose of promoting medication adherence and improving HTN-related health behaviours based on stages

of change and a health decision model, 32% of the patients complied with the exercise module (13). In a study by Fort (2015), including an educational intervention for a healthy lifestyle based on stages of change and self-efficacy in hypertensive patients, no significant changes were observed with regard to self-efficacy and participation in PA (14).

2. Objectives

In light of the poor results obtained in the interventions mentioned above and because the integration of stages and processes of change can provide a beneficial guide for PA interventions (11), it would seem that adding the processes of change to PA interventions would be useful in increasing their effectiveness. Therefore, this study was designed to evaluate the effects of a TTM-based intervention on the PA of patients with HTN.

3. Methods

3.1. Trial Design

This was a concurrent parallel randomized clinical trial. Participants were individually randomized to parallel groups. Unit of randomization was patient. Study objectives were explained to each participant and informed written consent was obtained. The study was confirmed by the ethics committee of Tarbiat Modares University. This study is registered at www.irct.ir (No. IRCT2016061428463N1).

3.2. Participants

Inclusion criteria were that patients should be diagnosed with primary HTN; have a systolic BP of less than 170 mmHg; be taking at least one anti HTN medication; have completed at least 4th grade education, have no orthopedic limitations to walking; be cleared for moderate-intensity walking by a cardiologist; have a current PA level that is less than the criterion (30 minutes of fast walking five days a week); be in the stage of pre-contemplation, contemplation or preparation; and be ≤ 69 years of age. Exclusion criteria were diagnosis of cardiovascular disease, diabetes or depression; history of heart attack or stroke; and taking drugs for weight loss.

3.3. Setting and Locations Where the Data Were Collected

The study took place at the Shiraz healthy heart house in Shiraz, Iran, from January 2015 to March 2016. Individuals with HTN were selected by Purposive sampling from patients referred to the Shiraz healthy heart house. Healthy heart house is affiliated to the cardiovascular research center of Shiraz University of Medical Sciences and promotes

population-based cardiovascular disease prevention activities. Shiraz is among the large cities in Iran, with a population of 1,460,445 (15) and an estimated HTN prevalence of 27.5% in adults 19 - 99 years in 2010 (16).

3.4. Interventions

Thirty one patients in the experimental group (EG) were divided into 3 groups. A four-session training program totaling 8 hours was attended by the experimental participants. Meetings were held on a weekly basis. Commensurate with the constructs of processes of change appropriate content and teaching methods were used. For example, for self-reevaluation used from role playing. Examples of strategies used for each process of change is in Table 1 (8, 17). The first session discussed consciousness raising, dramatic relief and how to take a pulse. The second session was about self re-evaluation, environmental re-evaluation, social liberation, self-liberation. The third session presented helping relationships, counter-conditioning, reinforcement management and stimulus control. The fourth session determined the target heart rate of each person during exercise using the karvonen formula (18). Each subject was told their target heart rate and asked to take his/her pulse while walking to attain this value. Subjects were shown a video teaching fast walking and were instructed practically by an exercise coach. At least 30 minutes of fast walking at an intensity of 40% to 60% maximum heart rate was prescribed to the EG for at least 5 days a week for 6 months. During implementation, no additional intervention by researchers was provided to the control group (CG). After the training sessions, the members of the EG were followed up by phone and short message system once every two weeks for first 3 months and every month for the 3 next months.

3.5. Outcomes

1- PA stages of change: PA stages of change was measured using stages of PA change questionnaire developed by Marcus et al. (19). Patients were asked to show which options best described their current level of PA (walking, biking, or playing ball for 30 minutes or more, 5 days a week) as active more than 6 months (maintenance), active less than 6 months (action), not active on a regular basis but occasionally engaged in activities and planning to start next month on a regular basis (preparation), not active but may start in the next 6 months (contemplation), not active and not planning to start in the next 6 months (pre-contemplation) (20). The validity and reliability of the questionnaire have been confirmed in Iran by Roozbahani (20). The PA stages of change were measured before, 3 and 6 months after intervention.

Table 1. Processes of Change, Description and Examples of Strategies^a

Processes of Change	Description	Examples of Strategies
Consciousness raising	Finding and learning new facts, ideas, and tips that support the healthy behavior change	give information about physical activity and its advantages and risks related to inactivity
Dramatic relief	Experiencing the negative emotions (fear, anxiety, worry) that go along with unhealthy behavioral risks	health risk feedback
Self re-evaluation	Realizing that the behavior change is an important part of one's identity as a person	healthy role models
Environmental reevaluation	Realizing the negative impact of the unhealthy behavior reevaluation or the positive impact of the healthy behavior on one's proximal social and/or physical	Empathy training
Social liberation	Realizing that the social norms are changing in the direction of supporting the healthy behavior change	Show alternative to the problematic behavior
Self liberation	Making a firm commitment to change	Technics of goal fixation, make plan about physical activity
Helping relationships	Seeking and using social support for the healthy behavior change	Education important others(spouse, Relative ,Friend, ...) in the direction encourage and support of physical activity
Counterconditioning	Substitution of healthier alternative behaviors and cognitions for the unhealthy behavior	recognize the situation that lead to inactive and the different scenario that can be established to include physical activity
Reinforcement management	Increasing the rewards for the positive behavior change and decreasing the rewards of the unhealthy behavior	Make a reward list for each reached goal of physical activity
Stimulus control	Removing reminders or cues to engage in the unhealthy behavior and adding cues or reminders to engage in the healthy behavior	Give some photos or message that can motive doing physical activity

^aObtained from Romain (8) and Glanz (17).

2- Processes of change: Processes of change were evaluated using a 40-item scale (19). The instrument assesses 10 processes of change (19). Processes of change are shown in Table 1 (8, 17). Participants responded to the questions on a scale ranging from 1 to 5 (never to repeatedly) A higher score shows more frequent use of processes of change to perform PA score range (1 - 5) (21). The validity and reliability of the questionnaire have been confirmed in Iran by Roozbahani (20). Processes of change was measured before, 3 and 6 months after intervention.

3- Frequency and duration of walking: Frequency and duration of walking were measured using the international PA questionnaire (IPAQ) short form (22). The validity and reliability of the questionnaire have been confirmed in Iran by Moghadam (23). Frequency and duration of walking was measured before, 3 and 6 months after intervention.

4- Intensity of walking: Intensity of walking was measured using the Borg scale ranging from 6 (light effort) to 20 (fatigue) (24). The validity and reliability of the questionnaire have been confirmed in Iran by Parvari (24). Intensity of walking was measured before, 3 and 6 months after intervention.

3.6. Sample Size

According to Hashemi et al. study (25), at a 95% confidence interval and 90% power using the. Following formula (26) the sample size for the present study was determined to be 25 subjects for each group. Potential loss to follow-up was anticipated to be 20% per group, so 30 subjects were planned to be randomized to each group.

$$n = \frac{p1(100 - p1) + p2(100 - p2)}{(p2 - p1)^2} \times f(\alpha\beta) \quad (1)$$

p1 = The proportion of people entered in the stage of action in EG.

p2 = The proportion of people entered the stage of action in CG

3.7. Randomization

Patients were randomly assigned following unrestricted randomization procedures (flip of the coin) to 1 of 2 EG or CG. Randomization was concealed in sequentially numbered, opaque, sealed and stapled envelopes. Investigators generated the random allocation sequence, enrolled participants and assigned participants to interventions.

3.8. Blinding

Investigators and patients (was not possible to blind participants given the nature of the intervention) that allocated to the EG were aware of the allocated arm, outcome assessors and data analysts were kept blinded to the allocation.

3.9. Statistical Methods

The data was analyzed using SPSS 22 software. Kolmogorov-Smirnov statistical test used for assess normal distribution of data. Data was analyzed using tests of chi-square, independent t-test, repeated measure and Mann-Whitney and freedman tests for non-parametric data. The results were considered significant at $P < 0.05$.

4. Results

This study was conducted on 60 patients with HTN (31 EG, 29 CG) without loss of participants. Table 2 shows the baseline characteristics of the EG and CG. Before intervention there was no significant difference between the EG and CG in the PA stages of change, processes of change, frequency, duration and intensity of walking ($P > 0.05$).

4.1. PA Stages of Change

At 3 and 6 months post-intervention, EG showed improvement in PA stages of change compared to CG ($P < 0.001$, Table 3). At 3 months post-intervention, in the EG, 87.1% patients ($n = 27$) and in the CG, 27.6% patients ($n = 8$) entered to the stage of action. At 6 months post-intervention, in the EG, 74.2% patients ($n = 23$) and in the CG, 13.8% patients ($n = 4$) entered the stage of action or maintenance (Table 3).

4.2. Processes of Change

At 3 months post-intervention, the mean total scores for the cognitive and behavioral processes of consciousness raising, dramatic relief, self-re-evaluation, environmental re-evaluation, counter-conditioning, reinforcement management, self liberation and stimulus control differed significantly between the EG and CG ($P < 0.05$, Table 4). At 6 months post-intervention, the mean total scores for the behavioural and cognitive processes of consciousness raising, self-re-evaluation, environmental re-evaluation, counter-conditioning, helping relationships, reinforcement management and stimulus control differed significantly between the EG and CG ($P < 0.05$, Table 4).

Table 5 indicated changes of processes of change over time (pre intervention, 3 month post intervention and 6

Table 2. Baseline Demographic and Clinical Characteristics^{a,b}

Patient Characteristics	Experimental (n = 31)	Control (n = 29)	P Value
Age, y	54.05 ± 7.01	53.75 ± 8.27	0.561
Gender			0.603
Male	12 (38.7)	14 (48.3)	
Female	19 (61.3)	15 (51.7)	
Job			0.683
Laborer	4 (12.9)	4 (13.8)	
Employee	0 (0)	2 (6.9)	
Self-employment	2 (6.5)	2 (6.9)	
Housewife	14 (45.2)	12 (41.4)	
Retired	11 (35.5)	9 (31)	
Education			
Under high school	12 (38.7)	15 (51.7)	0.235
High school	9 (29)	10 (34.5)	
College education	10 (32.3)	4 (13.8)	
Income (\$ US)	349.5 ± 204.51	291.52 ± 199.22	0.204
Number of anti HTN drugs	1.61 ± 0.72	1.47 ± 0.612	0.589
Duration of consumption anti HTN drugs, y	3.77 ± 2.21	5.89 ± 6.55	0.733

^aValues are expressed as No. (%).

^bAge, income, number and duration of consumption of anti HTN drugs are presented as mean ± SD. Intergroup difference were tested by unpaired 2-tailed tests (age, income, number and duration of consumption of anti HTN drugs), Fisher exact test (gender) and Pearson χ^2 test (job, education).

month post intervention) in the EG. Cognitive and behavioral processes, consciousness raising, environmental re-evaluation, social liberation, counter-conditioning, helping relationship, reinforcement management, self liberation and stimulus control differed significantly in over time in EG group ($P < 0.05$, Table 5). At 3 month post-intervention two processes of helping relationship and stimulus control and at 6 months post-intervention helping relationship and strengthening management had the most increase compared to before intervention. Table 6 indicated changes of processes of change over time in the CG. In the CG, significant difference was observed in behavioral processes, counter-conditioning and self liberation at 6 months post-intervention as compared with 3 month post intervention (Table 6).

Table 3. Physical Activity Stages of Change in Experimental and Control Groups^a

Variables	Baseline		P Value ^b	3 month Follow-Up		P Value ^b	6 month Follow-Up		P Value ^b
	Experimental	Control		Experimental	Control		Experimental	Control	
Pre-contemplation	2 (6.5)	5 (17.2)	0.327	0	10 (34.5)	< 0.001	0 (0)	4 (13.8)	< 0.001
Contemplation	7 (22.6)	8 (27.6)		1 (3.2)	7 (24.1)		1 (3.2)	10 (34.5)	
Preparation	22 (71)	16 (55.2)		3 (9.7)	4 (13.8)		7 (22.6)	11 (37.9)	
Action	-	-		27 (87.1)	8 (27.6)		10 (32.3)	2 (6.9)	
Maintenance	-	-		-	-		13 (41.9)	2 (6.9)	

^aValues are expressed as No. (%).^bDerived from Chi-square test.**Table 4.** Comparison Processes of Change and Frequency, Duration and Intensity of Walking in Experimental and Control Group^{a,b}

Parameter	3-month Follow-Up		P Value	6-month Follow-Up		P Value
	Experimental	Control		Experimental	Control	
Processes of change	3.71 ± 0.76	3.14 ± 0.74	0.03	3.95 ± 0.59	3.46 ± 0.54	0.002
Cognitive processes	3.81 ± 0.72	3.30 ± 0.72	0.03	4.06 ± 0.50	3.54 ± 0.52	< 0.001
Consciousness raising	3.76 ± 0.92	2.89 ± 0.98	0.002	3.90 ± 0.88	2.97 ± 0.95	< 0.001
Dramatic relief	4.17 ± 0.95	3.53 ± 1	0.03	4.24 ± 0.75	3.87 ± 0.74	0.07
Self re-evaluation	4.34 ± 0.57	3.63 ± 0.86	0.002	4.52 ± 0.50	4.16 ± 0.50	0.01
Environmental reevaluation	3.81 ± 0.75	3.11 ± 0.97	0.006	4.12 ± 0.66	3.56 ± 0.75	0.005
Social liberation	3.25 ± 0.89	2.82 ± 0.98	0.141	3.52 ± 0.84	3.12 ± 0.88	0.08
Behavioral processes	3.65 ± 0.79	3 ± 0.91	0.01	3.85 ± 0.72	3.38 ± 0.64	0.01
Counter conditioning	3.80 ± 0.84	3.02 ± 0.95	0.006	4.08 ± 0.79	3.61 ± 0.81	0.03
Helping relationships	3.29 ± 1.08	2.78 ± 1.16	0.117	3.65 ± 1.13	3.03 ± 1.06	0.03
Reinforcement management	3.64 ± 1.04	3.06 ± 1.07	0.05	3.98 ± 0.85	3.53 ± 0.79	0.04
Self liberation	4.30 ± 0.66	3.49 ± 0.85	< 0.001	4.11 ± 0.69	3.88 ± 0.59	0.18
Stimulus control	3.45 ± 1.06	2.59 ± 1.09	0.008	3.43 ± 1.02	2.86 ± 0.98	0.03
Frequency of walking	5.23 ± 1.56	2.71 ± 2.85	< 0.001	5.03 ± 1.79	4.76 ± 2.28	0.63
Duration of walking	45.33 ± 30.93	25.38 ± 36.13	0.001	42.20 ± 18.82	32.29 ± 30.43	0.01
Intensity of walking	13.66 ± 2.75	9.75 ± 3.40	< 0.001	12.96 ± 2.02	11.66 ± 1.49	0.006

^aValues are expressed as mean ± SD.^bDerived from independent t-test.

4.3. Frequency and Duration of Walking

At 3 months post-intervention, frequency of walking differed significantly between the EG and CG ($P < 0.001$, Table 4). At 6 months post-intervention, frequency of walking did not differ significantly between the EG and CG ($P = 0.63$, Table 4). At 3 and 6 months post-intervention, duration of walking differed significantly between the EG and CG (Table 4). In the EG, frequency of walking was significantly different over time ($P = 0.01$, Table 5). In the CG, frequency of walking significantly differed at 6 months post-intervention compared to 3 months post intervention ($P = 0.03$, Table 6).

4.4. Intensity of Walking

At 3 and 6 months post-intervention, Intensity of walking differed significantly between the EG and CG ($P < 0.05$, Table 4). In the EG, intensity of walking was significantly different at over time ($P = 0.05$, Table 5). In the CG, Intensity of walking were not significantly different over time ($P = 0.06$, Table 6).

5. Discussion

The present study tested the effect of an intervention program based on TTM in patients with HTN. In the present

Table 5. Processes of Change ,Frequency, Duration and Intensity of Walking in Experimental Group^a

Parameter	Experimental			P Value ^b
	Baseline	3-month Follow-Up	6-month Follow-Up	
Processes of change	3.46 ± 0.62	3.94 ± 0.90	3.96 ± 0.63	0.001
Cognitive processes	3.66 ± 0.66	3.95 ± 0.70	4.08 ± 0.51	0.003
Consciousness raising	3.46 ± 1	3.81 ± 0.91	3.90 ± 0.93	0.04
Dramatic relief	4.19 ± 0.97	4.20 ± 0.89	4.29 ± 0.74	0.66
Self re-evaluation	4.18 ± 0.72	4.38 ± 0.61	4.50 ± 0.48	0.33
Environmental reevaluation	3.52 ± 0.92	3.93 ± 0.80	4.18 ± 0.65	0.01
Social liberation	2.90 ± 0.95	3.39 ± 0.85	3.53 ± 0.87	0.004
Behavioral processes	3.27 ± 0.64	3.93 ± 1.23	3.83 ± 0.80	0.002
Counter conditioning	3.65 ± 0.77	4.35 ± 2.23	4.22 ± 0.67	0.004
Helping relationships	2.72 ± 1.22	3.73 ± 2.47	3.62 ± 1.20	0.04
Reinforcement management	3.19 ± 0.90	3.70 ± 1.01	4.01 ± 0.88	< 0.001
Self liberation	4 ± 0.82	4.32 ± 0.69	4.18 ± 0.67	0.05
Stimulus control	2.81 ± 1.02	3.54 ± 1.15	3.39 ± 1.09	0.005
Frequency of walking	4 ± 2.14	5.12 ± 1.67	5.20 ± 1.74	0.01
Duration of walking	40 ± 32.85	39.56 ± 25.44	42.60 ± 19.47	0.64
Intensity of walking	12.25 ± 2.62	13.88 ± 2.96	12.95 ± 2.11	0.05

^aValues are expressed as mean ± SD.^bP value derived from repeated measure.

study, progress in the stages of change was considered one of the criteria for success in intervention. At 3 and 6 months post-intervention, the EG showed improvement in PA stages of change compared to CG. Studies of Mutrie (27), Woods (11), Plow (21) about trans-theoretical-based intervention on physical activity reported similar results. At 3 months post-intervention 87.1% of the EG and at 6 months post-intervention 74.2% of the EG regularly active (action or maintenance). These amounts in CG was 27.6% and 13.8% respectively. In the study of Daley (28), stage specific intervention in hypertensive women, 4 weeks after the intervention %85 women proceeded to or stayed in the action or maintenance stages of change that is consistent with this study.

At 3 and six months post-intervention, a significant difference was observed between the EG and CG in behavioural and cognitive processes. This result is consistent with studies of Moeini (29) and Van Sluijs (30) with the purpose of evaluating trans-theoretical based intervention on PA in under investigation patients. In study of Pirzade (31) on 141 patients with metabolic syndrome also 6 months after intervention significant difference were seen in the processes of change between the EG and CG. These findings showed that intervention was effective in increasing use of

the processes of change.

At 3 months post-intervention, walking increased significantly in the EG compared to the CG. Jalilian's (32) study with purpose of investigating the effect of physical activity, stage-matched intervention on 50 diabetic patients showed that intervention group performed significantly more regular physical activity than CG. At 6 months post-intervention, walking increased in EG compared to the CG but not significantly. Study of Gong (33) about efficacy of behavioral intervention (KM2H²) by trans-theoretical model among hypertensive patients indicated that actual physical activity levels were significantly higher for intervention participants than for the control participants at 6 months post intervention. In the study of Pirzade (31) with the purpose of evaluating trans theoretical model to promote physical activities among 141 women with metabolic syndrome, walking increased in case group compared to the CG at 6 months post intervention. Reason of increased physical activity in studies of Gong and Pirzade compared to the current study can attributed to Gong's study including patients that were in all stages of change (pre contemplation, contemplation, preparation, action and maintenance) and in Pirzade's study included patients that were in stages of contemplation and preparation and action

Table 6. Processes of Change and Frequency, Duration and Intensity of Walking in Control Group^a

Parameter	Control			P Value ^b
	Baseline	3-month Follow-Up	6-month Follow-Up	
Processes of change	3.32 ± 0.75	3.17 ± 0.88	3.41 ± 0.69	0.17
Cognitive processes	3.52 ± 0.71	3.44 ± 0.99	3.51 ± 0.67	0.89
Consciousness raising	3.25 ± 1.11	3.04 ± 0.92	2.92 ± 1.08	0.42
Dramatic relief	3.62 ± 1.01	3.33 ± 1.09	3.75 ± 0.79	0.87
Self re-evaluation	4.10 ± 0.89	4.55 ± 2.92	4.12 ± 0.56	0.55
Environmental reevaluation	3.72 ± 1.02	3.32 ± 1.11	3.63 ± 0.99	0.24
Social liberation	2.92 ± 1.09	2.84 ± 1.17	3.11 ± 1.12	0.59
Behavioral processes	3.12 ± 0.85	2.90 ± 0.83	3.31 ± 0.81	0.01
Counter conditioning	3.64 ± 0.97	2.98 ± 0.92	3.58 ± 1.05	0.02
Helping relationships	2.41 ± 1.19	2.42 ± 1.11	2.78 ± 1.33	0.16
Reinforcement management	2.95 ± 1.02	3.10 ± 1.06	3.35 ± 0.95	0.17
Self liberation	3.80 ± 0.90	3.46 ± 0.79	3.98 ± 0.69	0.01
Stimulus control	2.78 ± 1.17	2.52 ± 1.08	2.86 ± 1.08	0.35
Frequency of walking	3.74 ± 2.44	2.47 ± 2.96	4.31 ± 2.40	0.03
Duration of walking	37.35 ± 36.14	30.58 ± 39.12	31.47 ± 34.94	0.49
Intensity of walking	11.28 ± 2.67	9.61 ± 3.44	11.55 ± 1.61	0.06

^aValues are expressed as mean ± SD.^bP-value derived from repeated measure

at pre intervention. Whereas this study entered patients that were in pre-action stages (pre-contemplation, contemplation and preparation) in which it was hard motivating patients compared to action stages. Of course at 6 months post-intervention; frequency, duration and intensity of walking in EG (5.03, 42.20, 12.96, respectively) compared with CG (4.76, 32.29, 11.66, respectively) indicated that EG reached the purpose of intervention (30 minutes of fast walking at least 5 days a week for 6 months). This situation shows that with regard to the existence of obstacles and competitive conditions against exercise, continuation of educational measures or reinforcing communication seems necessary.

In the EG a significant increase was observed in the use of the 8 the processes of change over time. In the EG 3 month post-intervention, two processes of helping relationship and stimulus control and 6 months post-intervention, helping relationship and strengthening management had the most increase compared to before intervention. Helping relationship and stimulus control and strengthening management are behavioral processes. According to findings of Plotnikoff (34) and Sullum (35), the role of behavioural processes in predicting the transfer of individuals during the stages of change is

more obvious than in the cognitive processes. Findings in studies of Griffin-Blake (36) and Prapavessis (37) is indicative of the great effect the use of behavioral processes in action and maintenance stages. Since in 6 months post-intervention a significant proportion of the EG were in the action or maintenance stages, increased use of these two behavioral processes is justifiable.

In the CG, frequency of walking, behavioral processes, counter-conditioning and self liberation were significantly higher at 6 months post-intervention compared to 3 months post intervention. In Eakin study, The Logan Healthy Living Program, a significant improvement in PA in the CG occurred (38). A recent systematic review also indicated that in nearly 30% of PA interventions, a significant improvement in PA was observed in the CG (39). In studies of Mostafavi (7) and Moeini (40) significant difference was also observed in processes of change in CG at post intervention compared with pre intervention that was consistent with this study. Reasons of CG improvements in this study could be: 1. the effects of measurement (when measurement is sufficient to produce a change in behavior in the absence of a formal intervention). 2. education that about the prevention of cardiovascular diseases and specifically doing PA occurred frequently in recent years by media. CG

could be affected by this education.

The limitation of this study was the use of self-reported PA data. By providing explanations and using effective communication, we attempted to gain the confidence of the participants and keep the amount of biased self-reporting to a minimum. This study included several strengths: 1) This is the first study that tested the effect of the processes of change on the PA of patients with HTN; and 2) Valid and reliable questionnaires were used to assess the impact of the intervention on the determinants of PA.

The present study showed that TTM-based intervention effectively increased the PA stages of change, processes of change and walking. So use of TTM-based interventions can be suggested for increased commitment to PA in hypertensive patients.

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Footnote

Conflicts of Interests: The authors report no conflicts of interest.

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