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The relationship between blood pressure and physical activity without induced programmes

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Objective

Scheduled exercise programmes improve cardiovascular risk profile. However, long-term attendance in these programmes is extremely low. In this study, we aimed to investigate the association between habitual daily activity levels of the subjects and their cardiovascular risk profile with particular attention to blood pressure (BP) levels.

Materials and Methods

292 subjects were enrolled in the study. All of the subjects completed the International Physical Activity Questionnaire. Their cardiovascular risk profile and BP levels were also recorded. Subjects were divided into 3 subgroups according to their weekly total metabolic equivalent count as low, moderate and high activity groups. Comparison of these three groups with regard to cardiovascular risk status and BP levels was performed. The effect of physical activity level on BP control was also assessed.

Results

The numbers of subjects with low, moderate and high exercise level were 154, 91 and 47 respectively. Two hundred and thirty subjects were hypertensive and 105 of them had uncontrolled hypertension. The cardiovascular risk status and BP levels did not differ among low, moderate and high activity groups. Among the hypertensive

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population, those with uncontrolled hypertension were significantly less active those with controlled hypertension.

Conclusion

Blood pressure control in this hypertensive population was found to be associated with their weekly physical activity levels. This finding is important to highlight the effects of daily lifestyles on cardiovascular outcomes.

Key words

Hypertension, physical activity, sedentary life, blood pressure control

Introduction

Economic development and modern technology have simplified life for humanity. In the modern world, we have reduced use of our muscles and generally replaced many of our basic functions with machines. We invest much mental effort in how we can walk less (escalators, elevators, conveyor belts, etc.).

Sedentary lifestyle is known to be related to hypertension, hypercholesterolemia, atherosclerosis and atherosclerosis-related cardiovascular diseases [1]. Regular physical activity can reduce cardiovascular risk. Some studies show the effect of physical activity in reducing blood cholesterol levels and BP [2,3]. Success of scheduled programmes and induced physical activities has been demonstrated in previous studies [4,5]. However, each person has different daily physical activity in normal life and it is not well established whether the BP levels differ according to daily physical activity of individuals in the absence of any scheduled programme.

Hypertension is one of the leading causes of death in the world. Its prevalence in Turkey is 31.8% [6]. Achieving optimal control of high BP is difficult. Usually more than two drugs are needed to control BP [7]. Among patients on antihypertensive therapy, only 20% of patients have controlled BP. The ratio of controlled BP in general population is only 8% [6].

In this cross-sectional study, we aimed to investigate whether the weekly physical activity status of patients has an impact on BP control. Additionally, we aimed to determine the physical activity status and ratio of antihypertensive drugs usage in our geographical area.

Methods

The study was conducted in Balcova, Izmir, which is an urban area at the western site of Turkey. A total of 340 subjects were examined for this study; 190 of those through clinic visits and 150 through home visits. After excluding ineligible subjects due to inadequate medical information, 292 subjects were enrolled in the study. Home visits were conducted at different times of a day. Cases for home visits were selected from local elective lists via a random numbers method. Educated medical school students and two investigators (Şimşek MA, Kangül H) did home visits. Hypertensive to normotensive volunteer ratio was planned as 3/1. All subjects gave informed consent and the study protocol was approved by our Institutional Review Board.

Inclusion criteria:

- People older than 18 years old
- Hypertensive patients (according to the Seventh Report of the *Joint National Committee* (JNC 7): mean systolic BP≥140 mmHg or mean diastolic BP≥90 mmHg, or previously diagnosed and/or taking antihypertensive drugs) [8].

Exclusion criteria:

- People with scheduled sportive programme
- Physical disability
- Answering the *International Physical Activity Questionnaire* (IPAQ) inappropriately
- Active systemic disease

Blood pressure was measured according to the *JNC-7* recommendations with aneroid sphygmomanometer (Riester, Rudolf Reister GmbH&Co, Jungingen, Germany). Validated short Turkish version of IPAQ was used to measure weekly physical activity [9]. Mean weekly physical activity was calculated as metabolic equivalent (MET) for each person. Less than 600 MET was defined as low physical activity level; 600–1500 MET as moderate level; and, more than 1500 MET as high level.

Statistical Analysis

SPSS statistical software (SPSS for Windows 15.0, Chicago, IL, USA) was used for all statistical calculations. Continuous variables were given as mean ± SD, and categorical variables were defined as a percentage. Differences between groups were tested using

one-way analysis of variance (ANOVA), t-test and x^2 test when appropriate. Pearson correlation was used to evaluate the association between the parameters. Statistical significance was defined as $P<0.05$.

Results

230 hypertensive and 62 normotensive volunteers were enrolled in this study. The mean age of total study population was 56.5±13.5 (19–86). Among the entire studied group, 154 (52.7%) were female; 59 (20.2%) were diabetic; 101 (34.6%) were hyperlipidemic; and, 95 (32.5%) were active smokers. Mean body mass index (BMI) of the 292 subjects was 27.8±4.4 (16.5–41.0). Both hypertensive and normotensive volunteers have comparable physical activities but normotensive ones were significantly younger and thinner (Table 1).

Hypertensive patients were divided into two groups according to the presence of optimal BP control. One hundred and twenty five patients with BP<140/90 mmHg were accepted as regulated and 105 patients with BP≥140/90 mmHg as unregulated. The regulated group was younger than unregulated but the difference was not significant. Weekly physical activity of regulated group was significantly higher than unregulated. Regulated group has significantly lower BMI than unregulated (Table 2).

Systolic and diastolic BP was analyzed for correlation with weekly physical activity level. Both have opposite relations with weekly physical activity level; however, the correlations were not significant (Table 3).

The studied population was divided into 3 groups, according to their weekly physical activity, as low, moderate and high. There were no significant differences between groups in respect of systolic and diastolic BP (Table 4). Among the hypertensive population, the rates of controlled BP levels were also similar between groups (Table 5).

Antihypertensive drug usage was applicable in 199 of 230 hypertensive patients. The ratio of antihypertensive drugs is shown in Table 6. Sixty nine patients were on beta-blockers and 130 were not. Patients taking beta-blockers had less weekly physical activ-

Table 1. **Physical activity, age and BMI of hypertensive and normotensive volunteers**

	Hypertensive (n=230)	Normotensive (n=62)	*P*
Physical activity (MET)	995.7 ± 1206.2	712.3 ± 990.5	0.14
Age (years old)	59.1 ± 12.0	47.1 ± 14.8	<0.05
BMI (kg/m²)	28.4 ± 4.4	25.8 ± 4.0	<0.05

Table 2. **Physical activity, age and BMI of regulated and unregulated groups in hypertensive patients**

	Regulated (n=125)	Unregulated (n=105)	*P*
Physical activity (MET)	1099.4 ± 1480.4	784.8 ± 732.6	<0.05
Age (years old)	57.7 ± 12.7	60.7 ± 10.9	0.053
BMI (kg/m²)	27.5 ± 4.2	29.4 ± 4.5	<0.05

Table 3. **Correlation of systolic and diastolic blood pressures with weekly physical activity**

	R	*P*
Hypertensive patients (n=230)		
Systolic BP (mmHg)	– 0.05	0.36
Diastolic BP (mmHg)	– 0.07	0.24
All cases (n=292)		
Systolic BP (mmHg)	– 0.90	0.17
Diastolic BP (mmHg)	– 0.92	0.16

BP = blood pressure

Table 4. **Systolic and diastolic blood pressures. Difference between low, moderate and high physical activity groups**

	Low	Moderate	High	*P*
All cases (n=292)	(n=154)	(n=91)	(n=47)	
Systolic BP (mmHg)	132.3 ± 16.7	131.4 ± 18.9	132.4 ± 17.5	0.91
Diastolic BP (mmHg)	78.6 ± 10.9	79.5 ± 9.9	77.5 ± 11.8	0.58
Hypertensive (n=230)	(n=120)	(n=70)	(n=40)	
Systolic BP (mmHg)	134.8 ± 17.7	135.3 ± 19.5	133.9 ± 16.8	0.93
Diastolic BP (mmHg)	79.8 ± 11.2	81.6 ± 10.4	77.8 ± 11.8	0.20
Normotensive (n=62)	(n=34)	(n=23)	(n=5)	
Systolic BP (mmHg)	123.7 ± 9.1	119.6 ± 10.3	117.0 ± 14.8	0.19
Diastolic BP (mmHg)	74.6 ± 8.6	73.5 ± 5.7	70.4 ± 7.1	0.50

BP = blood pressure

Table 5. **Ratio of patients with regulated and unregulated blood pressure between low, moderate and high physical activity groups**

	Low (n=120)	Moderate (n=70)	High (n=40)	*P*
Unregulated group	54 (45%)	33 (47%)	18 (45%)	0.95
Regulated group	66 (55%)	37 (53%)	22 (55%)	0.95

Table 6. **Antihypertensive drug usage**

Antihypertensive drugs	Patients number (n=199)*
ACEI	30 (15.1%)
ACEI + D	13 (6.5%)
ARB	44 (22.1%)
ARB + D	38 (19.1%)
BB	69 (34.7%)
CCB	38 (19.1%)
ARB + CCB	6 (3.0%)
ACEI + CCB	1 (0.5%)
D	9 (4.5%)
AB	4 (2.0%)

* There was no patient with beta blocker + diuretic. Some patients use more than one drug.
ACEI = angiotensin converting enzyme inhibitor;
D = diuretic;
ARB = angiotensin receptor blocker;
BB = beta blocker;
CCB = calcium channel blocker;
AB = alpha blocker

ity than others but the difference was not significant (952.5±1191.3 vs. 1022.0±1221.8, *P*=0.70).

Discussion

This study examined the relation between BP and weekly physical activity level obtained via IPAQ. There was no significant difference between hypertensive and normotensive volunteers with regard to their physical activity status. However, in the hypertensive group, physical activity level was found to be associated with BP control. Among hypertensive patients, the ones with optimal BP control were significantly more active than the patients with unregulated hypertension.

We found that normotensive patients were significantly younger than hypertensive. This was not an unexpected finding as the prevalence of hypertension increases with aging [6]. Although the BMI in normotensive patients was significantly lower than in hypertensive, their weekly physical activity level was surprisingly low. It is speculated that, as human metabolism gets slower with aging, the elderly people who have higher BP, BMI, cholesterol, etc. try to apply the offered lifestyle changes, causing them to be more active than they were.

When we focused on the hypertensive group, the weekly physical activity level of patients with regulated BP was significantly higher than of unregulated ones. Their BMI was significantly lower than unregulated patients, as expected. We have previously demonstrated that arterial stiffness was associated with resistant hypertension [10]. Arterial stiffness is known to be a primary reason for increased cardiac afterload and unregulated BP in the elderly. Shibata and co-workers demonstrated that aortic stiffening was not improved even after 1 year of progressive endurance exercise training in elderly patients, while left ventricular afterload was reduced [5]. Scheduled exercise programmes can improve some cardiovascular outcomes, but healthy aging can be related more with basal physical activity status of person than with scheduled exercise programmes. So we think that, increased basal physical activity yielded a better BP control probably due to an improvement in arterial stiffness. Although sedentary behaviours are closely associated with mortality, moderate-vigorous physical activity does not fully mitigate cardiovascular risks associated with sedentary life [1]. Our understanding is that, improvement of a sedentary lifestyle via basic lifestyle changes could be more effective than scheduled exercise programmes in decreasing cardiovascular risks. The more that people increase activity in their daily lives, the better their cardiovascular risk profile. To make certain conclusions, optimal energy expenditure via daily activities should be defined more clearly [11].

When the whole studied population was divided into 3 subgroups according to weekly physical activity level as low, moderate and high, no significant difference was found between the groups with regard to systolic and diastolic BP. The percentages of patients with unregulated hypertension were also not statistically different among these 3 groups. Quantification of physical activity level of the groups was achieved according to a MET value criteria recommended by IPAQ. However, categorizing the physical activity via this classification may not be as valuable as the total MET count. Celis-Morales and co-workers compared the accelerometer and IPAQ. Although they found an over-reporting of physical activity with IPAQ, many data proved the validity of IPAQ [12].

In our population, beta-blockers and rennin-angiotensin system blockers were the most frequently used antihypertensive drugs. Another interesting finding of our study was that there was no significant physical activity difference between the patients with and without beta-blockers. Although beta-blocker therapy is a well-known cause of decreased functional status, this was not the case in our study group.

In conclusion, this study illustrates how minor changes in sedentary lifestyles can cause better BP control. It is not always mandatory to apply strict exercise programmes to improve the cardiovascular risk profile. As long-term attendance to scheduled physical training is extremely low among patients, it is better to increase the physical activity level through habitual alterations of patients' daily lives. For assessment and quantification of the patients' physical activity level, IPAQ is a simple and valid tool. However, it depends on the patient's self-reporting and no definitive threshold level exists to define if a patient is physically active or not. More data are needed for optimal assessment of patients' physical activity level and for defining the targets.

Limitations

The parameters assessed in this study, other than the measured BP levels, are based on patients self-reporting. Almost half of the patients were evaluated via clinical visits. Thus, a "white coat" effect cannot be excluded in this population. The relatively small number of normotensive patients and mismatched basal characteristics of the normotensive and hypertensive patients can limit the accuracy of the comparison be-

tween these groups with regard to their physical activity status. However, this study was not designed for such a distinct purpose and therefore we did not seek to make the groups matched. In the hypertensive population, BP control was evaluated according to the measured BP levels. Variables, other than physical activity status, were not considered when assessing the level of BP control.

Conflict of interest: None declared

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