Original Article/นิพนธ์ต้นฉบับ

Factors Associated With Cardiorespiratory Fitness in Postmenopausal Women With Prehypertension in Thailand

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Abstract

Background: Cardiorespiratory fitness (CRF) is one of the most important components of physical fitness. Low levels of CRF are associated with high mortality risk.

Objective: To investigate factors associated with CRF in postmenopausal women with prehypertension.

Methods: A descriptive design was used in this study. Through purposive sampling, 84 postmenopausal women with prehypertension were recruited from Ratchaburi province. The data were collected by using the structured questionnaire with face-to-face interview. All of the participants were measured for CRF (estimated maximal oxygen uptake [VO_{2max}]). Data were analyzed using descriptive and inferential statistics.

Results: The results revealed that mean age of participants was 55.15 ± 7 years (range, 44 - 69 years). Most of them were married (69%), obtained primary education (76.2%), worked as farmer (76.2%), and none farmers (23.8%). Approximately half of them did not exercise (42.9%). CRF was associated with waist circumference ($r_p = -0.637$, $P < 0.001$), body mass index ($r_p = -0.562$, $P < 0.001$), heart rate ($r_p = -0.581$, $P < 0.001$), and occupation ($r_s = 0.396$, $P < 0.001$).

Conclusions: Factors including waist circumference, body mass index, and heart rate were negatively associated with CRF in postmenopausal women with prehypertension. The results suggest approaches for healthcare providers to develop programs promoting cardiorespiratory fitness among postmenopausal women with prehypertension to enhance their health status and prevent hypertension and cardiovascular risk factors.

Keywords: Cardiorespiratory fitness, Postmenopausal women, Prehypertension

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Introduction

Cardiorespiratory fitness (CRF) is the most important components of physical fitness because low CRF level is related to markedly increased risk of premature death from all causes, particularly from cardiovascular diseases. High levels of CRF are associated with higher intensity of habitual physical activity and several health benefits.[1, 2] In fact, CRF is associated with the ability to use large muscle, dynamic, moderate-to-vigorous intensity exercise for prolonged periods.[3] In addition, CRF can be used as an important surrogate measure of recent physical activity pattern. High CRF is strongly protective against the metabolic syndrome.[4] In consistent with a sport medicine study, it is suggested that lower CRF leads to a higher prevalence of metabolic syndrome in postmenopausal African-American women.[5]

A population-based long-term study suggests that CRF should be considered as a causal risk factor predicting future hypertension.[6] Furthermore, increased CRF levels are associated with reduced risk for low bone density in postmenopausal women.[7] Postmenopausal women are at increased risk for many health conditions, such as osteoporosis and cardiovascular diseases[8] due to hormonal change. Coronary artery disease is a cause of death in women, especially postmenopausal group.

Importantly, postmenopausal women have several factors to decrease CRF, therefore, increasing of CRF will help them to get more health benefits and improve their quality of life. However, there was no study about factors influencing CRF in postmenopausal women with prehypertension. Thus, the objective of this study is to investigate factors associated with CRF in postmenopausal women with prehypertension.

Methods

Participants

Participants in this study refers to postmenopausal women with prehypertension living in Paktor district, Ratchaburi province, Thailand for over 6 months. They had been diagnosed with prehypertension from screening medical record of Health Promoting Hospital. They were asked to refrain tea or caffeine and sit at least 5 - 10 min before blood pressure measurement. Their systolic blood pressure was 120 - 139 mmHg, and/or diastolic blood pressure was 80 - 89 mmHg at least twice from repeated measurement. They had not been treated with any type of antihypertensive medication and other hormones. This study was a part of the experimental study. The appropriate sample size was calculated by G* Power analysis[9] to detect the differences in primary outcomes between the experimental and control groups with minimal errors. The sample size was 42 participants in each group, totaling 84 participants. The study was approved by the Ethics Review Committee for research Involving Human Subjects, Health Sciences Group from Chulalongkorn University, Thailand, COA No. 232/2015 on December 18, 2015. Each participant gave written informed consent.

Measurement

A structured questionnaire with face-to-face interview was used for data collection including personal information and health status. All participants were measured for CRF (estimated maximal oxygen uptake [VO_{2max}]) and physical fitness consisting waist circumference, body mass index, heart rate, and blood pressure. Data were analyzed using descriptive and inferential statistics; Pearson product moment correlation, Spearman rank correlation, and point biserial correlation.

Assessment of CRF

In this study, the 6-minute walk test (6MWT) was measured to calculate estimated VO_{2max} in milliliters per kilogram of body weight per minute (mL/kg/min). To perform the VO_{2max} test, the postmenopausal women were asked to walk as fast as possible for 6 min along 50 yards (45.72 m) rectangular shape. The score was calculated from total distance of walking within 6 min. The estimated VO_{2max} was calculated as CRF value for submaximum exercise testing, according to the following formula:[10]

$$VO_{2max} \text{ (mL/kg/min)} = 70.161 + (0.023 \times 6MWT \text{ [m]}) - (0.276 \times \text{weight [kg]}) - (6.79 \times \text{sex, where male} = 0, \text{female} = 1) - (0.193 \times \text{resting heart rate [beats per minute]}) - (0.191 \times \text{age [year]})$$

Results

Among 84 postmenopausal women with prehypertension lived in the community of Ratchaburi province. Most of them were married (69%), obtained primary education (73.8%), and worked as farmer (76.2%). The median of personal income was 5001 - 10 000 baht (45.2%). Approximately half of them did not exercise (42.9%) (Table 1). Nearly all participants had exercise frequency for 0 - 2 days/week (67.9%). The mean age of participants was 55.15 ± 7 years (range, 44 - 69 years). Total of them had average of waist circumference 81.73 cm (standard deviation [SD], 9.56), body mass index 24.28 kg/m^2 (SD, 3.66), heart rate 78.13 bpm (SD, 9.9), and CRF 30.96 mL/kg/min (SD, 3.97) (Table 2). Pearson product moment correlation revealed that CRF was associated with body mass index ($r = -0.562$, $P < 0.001$) (Figure 1A), waist circumference ($r = -0.637$, $P < 0.001$) (Figure 1B), heart rate ($r = -0.589$, $P < 0.001$) (Figure 1C), body weight ($r = -0.630$, $P < 0.001$), diastolic blood pressure ($r = -0.389$, $P < 0.001$), systolic blood pressure ($r = -0.305$, $P = .005$), and age ($r = -0.284$, $P < 0.001$) (Table 3). For this study, occupation was divided to farmer and non-farmer. Point biserial correlation also showed that CRF was associated with occupation ($r = 0.396$, $P < 0.001$) (Table 3). There was no relationship between marital status, education level, income level, frequency of exercise day, and CRF.
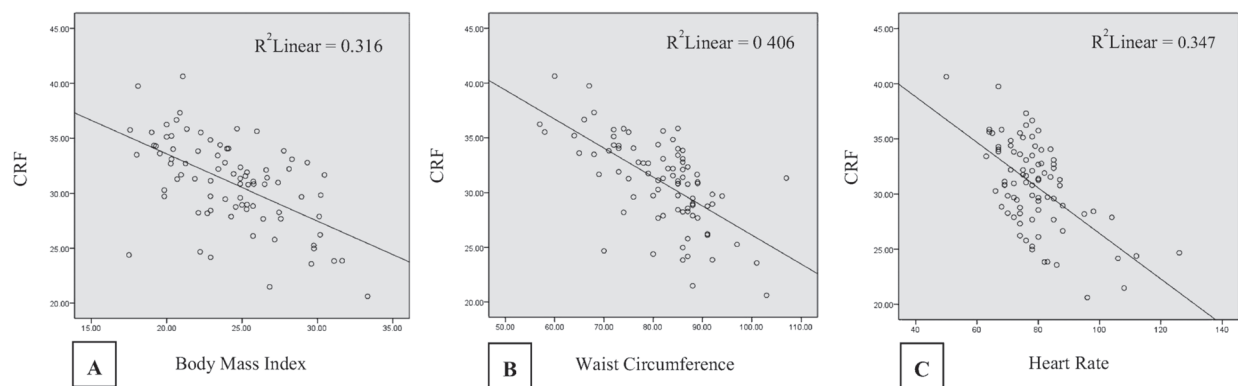
Table 1 Personal Characteristics of Postmenopausal Women With Prehypertension (N = 84)

Characteristic	No. (%)
Married status	
Single	9 (10.7)
Married	58 (69.0)
Widow	17 (20.3)
Education level	
Less than or equal primary level	64 (76.2)
Secondary level	20 (23.8)
Occupational	
Farmer	64 (76.2)
Non-farmer	20 (23.8)
Income, baht	
≤ 5000	36 (42.9)
5001 - 10 000	38 (45.2)
> 10 000	10 (11.9)
Exercise habit	
Get exercise	48 (57.1)
No	36 (42.9)

Table 2 Characteristics of Postmenopausal Women With Prehypertension (N = 84)

Characteristic	Mean ± SD	Min - Max
Age, y	55.15 ± 7.01	44 - 69
Waist circumference, cm	81.73 ± 9.56	57 - 107
Heart rate, bpm	78.13 ± 9.99	50 - 112
Systolic BP, mmHg	133.05 ± 13.71	120 - 167
Diastolic BP, mmHg	73.90 ± 9.17	54 - 96
Body weight, kg	58.00 ± 9.25	40 - 81
Body mass index, kg/m^2	24.28 ± 3.66	17.50 - 33.33
CRF (mL/kg/min)	30.96 ± 3.97	20.62 - 40.63

Abbreviation: BP, blood pressure; CRF, cardiorespiratory fitness; SD, standard deviation.

Figure 1 *Scatter Plot Showed Body Mass Index (A), Waist Circumference (B), and Heart Rate (C) Associated With Cardiorespiratory Fitness (CRF)*

Table 3 Correlation Matrix for Study Variables (N = 84)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
Pearson product moment correlation													
1	1												
2	-0.284**	1											
3	-0.630**	-0.162	1										
4	-0.637**	0.001	0.757**	1									
5	-0.562**	-0.187	0.871**	0.726**	1								
6	-0.305**	0.140	0.144	0.154	0.104	1							
7	-0.389**	-0.095	0.363**	0.259*	0.314**	0.744**	1						
8	-0.581**	0.025	-0.001	0.183	0.009	0.181	0.285**	1					
Point biserial correlation													
9	0.396**	-0.236*	-0.351**	-0.384**	-0.267*	-0.055	-0.033	-0.105	1				
Spearman rank correlation													
10	-0.063	-	-	-	-	-	-	-	-	1			
11	0.123	-	-	-	-	-	-	-	-	-0.049	1		
12	0.114	-	-	-	-	-	-	-	-	0.134	0.231*	1	
13	0.015	-	-	-	-	-	-	-	-	-0.018	0.271*	0.015	1

1 = Cardiorespiratory fitness; 2 = Age; 3 = Body weight; 4 = Waist circumference; 5 = Body mass index; 6 = Systolic blood pressure; 7 = Diastolic blood pressure; 8 = Heart Rate; 9 = Occupation (farmer and non-farmer); 10 = Marital status; 11 = Education level; 12 = Income level; 13 = Frequency of exercise day.

*$P < 0.05$.

**$P < 0.01$.

Discussion

In this study, low CRF was associated with high body mass index in postmenopausal women with prehypertension. It could be explained that body mass index in women results in a negative relationship with level of VO_{2max}.[11] In addition, the recent study mentioned that Japanese men with low average body mass index and high CRF were associated with lower cancer mortality.[12] Furthermore, the study on the independent roles of CRF in older adults demonstrated that older adults with a higher CRF had lower body mass index and fewer chronic health conditions but was not associated with physical activity levels or sedentary time,[13] consistent with the results in this study. A study published in *Journal of Women Health* also reported that in obese women, CRF was inversely associated with aortic stiffness.[14] However, the researcher recommended that high level of CRF may indirectly decrease aortic stiffness in women with central obesity which was desirable effect on several cardiovascular risk factors.[14] In support of this study, high CRF helped to prevent the increasing blood pressure in older people.[15]

Frequency of exercise was not associated with CRF. It was consistent with a recent gerontology study[16] demonstrating that physical activity was a crucial predictor of all causes mortality independently with VO_{2max} in older adults. In addition, physically inactive older adults who have high level of CRF does not necessarily confer low mortality risk.[16] It was implied that the frequency of exercise do not necessarily result in high CRF, so type of physical activity prescriptions should be emphasized intensity level and duration of exercise. That was why the type of physical activity prescriptions should offer to individual in need.

In overall, findings in this study were consistent with other study, indicating that CRF is important for promoting public health guidelines because it was a stronger predictor of health among older adults.[13] A scientific evidence also recommends that the benefits of exercise is undoubted and the beneficial effects of exercise greatly outweigh the risks in most adults. A regular exercise program consists of cardiorespiratory fitness, flexibility, resistance, and neuromotor exercises, in addition to daily activities to improve and maintain physical fitness, is essential for most adults.[17] Moreover, a recent study suggested that CRF is a stronger predictor of health among older adults and further emphasizes the crucial point of promoting public health guidelines for CRF improvement.[13]

Some limitations in the present study need to be mentioned. Measurement of estimated VO_{2max} for each participant was done at a single point in time, and data on acute illness such as fatigue was not known. Estimated VO_{2max} was calculated by the formula according to submaximal exercise test, which is not a gold standard. Most of the participants were farmers, therefore generalizability is limited.

Conclusions

Factors including waist circumference, body mass index, and heart rate have negatively affect CRF in postmenopausal women with prehypertension. The findings are useful for healthcare providers in the community to plan for developing interventions to support postmenopausal women with prehypertension, and monitor enhanced CRF, diminishing hypertension or cardiovascular diseases and improving their health status. Importantly, this information can be used to design an effective intervention for preventing hypertension in this population.

Acknowledgements

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Original Article/นิพนธ์ต้นฉบับ

ปัจจัยที่มีความสัมพันธ์กับสมรรถภาพของหัวใจและปอดในสตรีวัยหลังหมดระดูที่เป็นกลุ่มเสี่ยงโรคความดันโลหิตสูง

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บทคัดย่อ

บทนำ: สมรรถภาพของหัวใจและปอดเป็นองค์ประกอบที่สำคัญที่สุดของสมรรถภาพทางกาย ค่าสมรรถภาพของหัวใจและปอดที่ต่ำสัมพันธ์กับความเสี่ยงต่อการเสียชีวิตสูง

วัตถุประสงค์: เพื่อศึกษาปัจจัยที่มีความสัมพันธ์กับสมรรถภาพของหัวใจและปอดในสตรีวัยหลังหมดระดูที่เป็นกลุ่มเสี่ยงโรคความดันโลหิตสูง

วิธีการศึกษา: การศึกษาแบบบรรยาย กลุ่มตัวอย่างคือ สตรีวัยหลังหมดระดูที่เป็นกลุ่มเสี่ยงโรคความดันโลหิตสูงในจังหวัดราชบุรี จำนวน 84 คน สุ่มแบบเจาะจง การเก็บรวบรวมข้อมูลโดยการสัมภาษณ์ใช้แบบสอบถาม และการวัดสมรรถภาพของหัวใจและปอด (ค่าประมาณการใช้ออกซิเจนสูงสุด) วิเคราะห์ข้อมูลโดยใช้สถิติบรรยายและสถิติอ้างอิง

ผลการศึกษา: กลุ่มตัวอย่างมีอายุเฉลี่ยเท่ากับ 55.15 ± 7 ปี (ช่วงอายุ 44 - 69 ปี) ส่วนใหญ่มีสถานภาพสมรสร้อยละ 69 การศึกษาระดับประถมศึกษาร้อยละ 76.2 ประกอบอาชีพทำนาร้อยละ 76.2 และประมาณครึ่งหนึ่งไม่ได้ออกกำลังกายร้อยละ 42.9 ปัจจัยที่มีความสัมพันธ์กับสมรรถภาพของหัวใจและปอดอย่างมีนัยสำคัญทางสถิติ ได้แก่ เส้นรอบเอว ($r_p = -0.637$, $P < 0.001$) ดัชนีมวลกาย ($r_p = -0.562$, $P < 0.001$) อัตราการเต้นของหัวใจ ($r_p = -0.581$, $P < 0.001$) และอาชีพ ($r_s = 0.396$, $P < 0.001$)

สรุป: ปัจจัยซึ่งประกอบด้วย เส้นรอบเอว ดัชนีมวลกายและอัตราการเต้นของหัวใจ มีความสัมพันธ์เชิงลบกับค่าสมรรถภาพของหัวใจและปอดในสตรีวัยหมดประจำเดือนที่เป็นกลุ่มเสี่ยงความดันโลหิตสูง จากผลการศึกษานี้ชี้ให้เห็นแนวทางในการพัฒนาโปรแกรมส่งเสริมสมรรถภาพหัวใจและหลอดเลือดในสตรีวัยหมดประจำเดือนที่มีภาวะความดันโลหิตสูง เพื่อป้องกันโรคความดันโลหิตสูงและปัจจัยเสี่ยงต่อโรคหัวใจและหลอดเลือด

คำสำคัญ: สมรรถภาพของหัวใจและปอด สตรีวัยหลังหมดระดู กลุ่มเสี่ยงโรคความดันโลหิตสูง

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