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RESEARCH ARTICLE

PHYSICAL FITNESS AND HYPERTENSION RISK AMONG COMMUNITY DWELLING MIDDLE AGED AND OLDER ADULTS

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ABSTRACT

To explore the association of hypertension with health-related fitness among middle aged and elderly people by measuring blood pressure and health-related fitness indicators. The cross sectional study was conducted by using convenience sampling. The 4370 middle aged and elderly people took part in annual physical examination report of community-dwelling residents. Face-to-face interview was performed to obtain basic information. Health-related fitness was evaluated based on Annual National Physical Health Monitoring. Hypertension was diagnosed by annual physical examination report. Mann-Whitney U Test, Chi square Test and binary logistic regression model were used to analyzed the evaluating results. The overall prevalence of hypertension was 35.5% and 31.1% for male and female, respectively. In all groups, BMI and RHR had significant effects on the prevalence of hypertension for both male and female, before and after adjusting for demographic characteristics. Hypertension in the elderly is associated with physical fitness declining, while in the middle-aged is not. Increased BMI and RHR are always risking factors for hypertension. Significant positive associations were detected between the HGS and the incident risk of hypertension among the middle aged.

KEYWORDS

Health - related fitness, hypertension risk, middle aged, elderly people

1. INTRODUCTION

Physical fitness is considered a marker of current and future health in middle aged and the elderly hood involves several health-related components, such as cardio-respiratory and muscular endurance, muscular strength, speed-agility, flexibility, and balance. Some studies have shown that a low level of physical fitness is associated with cardiovascular diseases (Tanaka et al., 2012).

Hypertension is the leading preventable risk factor for cardiovascular disease (CVD) and all

cause mortality worldwide (Mills et al., 2020). Owing to widespread use of anti hypertensive medications, global mean blood pressure (BP) has remained constant or decreased slightly over the past four decades. By contrast in China, the prevalence of hypertension has increased, especially in Northern, China. Estimates suggest that in 2010, 31.1% of adults had hypertension. The prevalence of hypertension among adults was higher in China than in high income countries (28.5%) (Mills et al., 2020).

Variations in the levels of risk factors for hypertension, such as high sodium intake, low potassium intake, obesity, alcohol consumption, physical inactivity and unhealthy diet, may explain some of the regional heterogeneity in hypertension prevalence. Hypertension is the most important risk factor for cardiovascular disease among Chinese community-dwelling residents. At present, comprehensive prevention and control of chronic diseases were implemented, emphasizing the early screening of chronic diseases. There are warranted to test multifaceted implementation strategies for hypertension prevention and control, and to accurately assess the prevalence in China.

Despite it has been demonstrated that physical exercise is essential for blood pressure control and reduction of hypertension complications, few comprehensive assessments of the physical fitness impact on hypertension, and the association between health-related fitness and hypertension among middle aged and elderly people has been under investigated. Functional and quality tests confirmed that both the mild and moderate to severe hypertension groups were significantly lower than the normal intensive group in China (Flint et al., 2019). However, there may be a hypothesis that a'physical fitness paradox 'exists between middle aged and older adults with hypertension and the impact of physical fitness on hypertension is different among middle aged and elderly people. Therefore, it is needed to account for hypertension status when exploring the physical fitness –hypertension association. In this cross sectional study, we investigated the physical fitness according to different age categories by hypertension status among middle aged and older adults.

2. MATERIALS AND METHODS.

2.1 Study Participants and Ethics Statement.

This study is characterized as observational and community-based. The data used are part of a annual physical examination report of community-dwelling among middle-aged and elderly people and Annual National Physical Health Monitoring (ANPHM) is related to self-care in elderly in Huainan Longquan Community, China. A total of 4370 participants were included in the study (males: 1818): (1) age of ≥50 years old; (2) Provided sufficient information of annual physical examination report and questionnaires relating to physical fitness.

The study was approved by the Research Ethics Committee at the Huainan Normal University. Informed consent was obtained from all participants.

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2.1 Hypertension Diagnosis on Community-Dwelling Middle Aged and Elderly People.

Systolic and diastolic blood pressure was measured after rest using a tonometer. In the absence of anti hypertensive drugs, Hypertension was defined as blood pressure exceeded systolic blood pressure ≥ 140 mmHg and/ or diastolic blood pressure ≥ 90 mmHg three times not on the same day (Weber et al., 2014).

3. Data Analysis.

All analysis were conducted with Spss 25.0 software. The significance level was set at P<0.05, and P values were provided for two-sided tests. The count data was expressed as (n/%), and the difference between groups was analyzed using two independent sample $\chi 2$ test or Fisher's exact probability method. Continuous variables are expressed by means and standard deviations (SDs) for normally distributed variables and median values with inter-quartile ranges (IQR) for non-normally distributed data. Differences of variables between non-hypertension group and hypertension group were indicated by the independent sample Man-Whitney U test both in men and in women. Logistic regression was used adjusting for covariates.

Table 1: Characteristics of Participants.

Variables	Male (n = 1818)			Female (n = 2552)		
	Non-hypertension	Hypertension	P value	Non-hypertension	Hypertension	P value
Total	1240 (64.5)	578 (35.5)	0.000b	1758 (68.9)	794 (31.1)	0.077b
≦64 yr (1269)	905 (71.3)	364 (28.7)		1237 (70.0)	531 (30.0)	
≧ 65 yr (549)	335 (61.0)	214 (39.0)		521 (66.5)	263 (33.5)	
Age						
≦ 64	59 (54, 63)	59 (53, 63)	0.561a	60 (54, 62)	59 (53, 61)	0.121a
≧ 65	67 (65, 71)	69 (66, 72)	0.042a	70 (67, 73)	71 (67, 73)	0.168a
BMI						
≦64	24.3 (22.5, 26.0)	25.3 (23.7, 27.4)	0.000a	24.1 (22.3, 26.1)	25.6 (23.7, 27.4)	0.000a
≧ 65	24.5 (22.5, 26.6)	24.8 (23.3, 26.7)	0.023a	24.8 (22.7, 27.0)	25.7 (23.2, 27.7)	0.002a
RHR						
≦64	72 (68, 79)	78 (70, 84)	0.000a	74 (68, 80)	78 (70, 84)	0.000a
≧ 65	74 (68, 80)	78 (70, 85)	0.000a	72 (68, 80)	78 (70, 84)	0.000a
VC						
≦ 64	2540 (1946, 3349)	2910 (2120, 3635)	0.000a	2557 (1994, 3355)	2764 (1920, 3475)	0.055a
≧ 65	2813 (2181, 3482)	2516 (1810, 3425)	0.021a	1973 (1458, 2921)	1719 (1207, 2627)	0.001a
HGS						
≦64	30.4 (22.6, 40.6)	35.7 (27.4, 41.6)	0.000a	30.7(23.3, 41.5)	34.8 (25.5, 44.2)	0.000a
≧ 65	34.8 (27.4, 40.7)	38.7 (33.3, 43.5)	0.000a	24.5 (18.6,37.9)	23.3 (18.3, 35.4)	0.368a
SR						
≦64	6.3 (1.2, 12.4)	5.3 (-0.7, 10.7)	0.003a	6.4 (0.4, 12.9)	5.5 (-0.2, 11.0)	0.014a
≧ 65	3 (-2.8, 10.1)	2.3 (-3.3, 7.8)	0.169a	7.5 (1.9, 13.4)	8.0 (2.4, 13.1)	0.869a
SLS						
≦64	7 (4, 15)	8 (4, 18)	0.074a	7 (4, 15)	8(4, 15)	0.494a
≧ 65	6 (3, 14)	7 (4, 14)	0.052a	4 (3, 8)	4 (3,8.5)	0.505a
CRT						
≦64	0.58 (0.50, 0.72)	0.57 (0.48, 0.73)	0.337a	0.57 (0.49, 0.72)	0.57 (0.48, 0.72)	0.720a
≧ 65	0.62 (0.52, 0.87)	0.66 (0.51, 1.31)	0.011a	0.67 (0.53, 1.02)	0.80 (0.57, 1.18)	0.002a

a Mann-Whitney U Test ； b $\chi 2$ Test; BMI = body mass index (kg/m2); RHR = resting heart rate; VC = vital capacity; HGS = handgrip strength; SR = sit and reach; SLS = single - leg standing with eyes closed; CRT = choice reaction time.

4. Results

The overall prevalence of hypertension was 35.5% in male and 31.1% in female, respectively, and the incidence of hypertension was significantly higher in older men than in middle-aged men (older men 39%; middle aged men 28.7%).

In male, the hypertensive group was significantly older than that in the non-hypertensive group in ≧ 65 category, and the BMI, RHR and HGS were significantly higher in the hypertensive group than that in the non-hypertensive group both in both in ≦64 category and in ≧ 65 category, and the SR was significantly lesser in the hypertensive group than that in the non-hypertensive group in ≦ 64 category, and the CRT was longer in the hypertensive group than that in the non-hypertensive group in ≧ 65 category, whereas the VC was higher in the hypertensive group than that in the non-hypertensive group in ≦ 64 category and lower in the hypertensive group than that in the non-hypertensive group in ≧ 65 category.

In female, the hypertensive group was significantly older than that in the non-hypertensive group in ≧ 65 category too, and the BMI and RHR were significantly higher in the hypertensive group than that in the non-hypertensive group both in ≦64 category and in ≧ 65 category, and the VC was higher in the hypertensive group than that in the non-hypertensive group in ≦64 category, whereas was significantly lower in ≧ 65 category, and the SR was significantly lesser in the

hypertensive group than that in the non-hypertensive group in ≦ 64 category too, and the CRT was longer in the hypertensive group than that in the non-hypertensive group in ≧ 65 category too.

The association between each health-related fitness and hypertension in men and women are shown in Table 1 and Table 2, respectively. In men, increased BMI, RHR and HGS were associated with increased odds of hypertension both in ≦64 category (BMI: OR = 1.58, 95% CI = 1.39 - 1.81, p = 0.000; RHR: OR = 1.40, 95% CI = 1.22-1.60, p = 0.000; HGS: OR = 1.34, 95% CI = 1.18 - 1.51) and in ≧ 65 category (BMI: OR = 1.25, 95% CI = 1.05 - 1.48, p = 0.000; RHR: OR = 1.51, 95% CI = 1.24 -1.81, p = 0.000; HGS: OR = 1.42, 95% CI = 1.18 - 1.70, p = 0.000); whereas, increased SR was associated with decreased odds of hypertension (OR = 0.83, 95% CI = 0.73 - 0.93, p = 0.002) in ≦64 category, and increased VC was associated with decreased odds of hypertension (OR = 0.80, 95% CI = 0.69 - 0.94, p = 0.000) and increased CRT was associated with increased odds of hypertension in (OR = 1.67, 95% CI = 1.40 - 2.02, p = 0.000) ≧ 65 category. After adjusting for age, the associations between health - related fitness mentioned above and hypertension remained significant.

In women, increased BMI and RHR were associated with increased odds of hypertension both in ≦ 64 category (BMI: OR = 1.70, 95% CI = 1.53 - 1.90, p = 0.000; RHR: OR = 1.38, 95% CI = 1.24 - 1.54, p = 0.000) and in ≧ 65 category (BMI: OR = 1.24, 95% CI = 1.07 - 1.44, p = 0.000; RHR: OR = 1.39, 95% CI = 1.18 - 1.64, p = 0.000); whereas, increased HGS was associated with increased odds of hypertension (OR = 1.26, 95% CI = 1.14 - 1.40, p = 0.000) and increased SR was associated with decreased odds of hypertension (OR = 0.86, 95% CI = 0.78 - 0.96, p = 0.004) in ≦64 category, and increased CRT was associated with increased odds of hypertension in (OR = 1.23, 95% CI = 1.06 - 1.42, p = 0.000) ≧ 65 category. After adjusting for age, the associations between health - related fitness mentioned above and hypertension remained significant, too.

Table 2: Correlation of Hypertension and Physical Fitness.

Health-related fitness	Age group	Model1: crude, no ajustment				Model 2: ajusting for age			
		Exp(B)	95% CI for OR		P Value	Exp(B)	95% CI for OR		P Value
			Lower	Upper			Lower	Upper	
Male (n= 1818)									
BMI	≦64 (1269)	1.58	1.39	1.81	0.000	1.58	1.39	1.80	0.000
	≧ 65 (549)	1.25	1.05	1.48	0.000	1.25	1.05	1.48	0.000
RHR	≦64 (1269)	1.40	1.22	1.60	0.000	1.41	1.23	1.61	0.000
	≧ 65 (549)	1.51	1.24	1.81	0.000	1.52	1.24	1.86	0.000
VC	≦64 (1269)	--	--	--	--	--	--	--	--
	≧ 65 (549)	0.80	0.69	0.94	0.000	0.78	0.65	0.94	0.000
HGS	≦64 (1269)	1.34	1.18	1.51	0.000	1.36	1.20	1.55	0.000
	≧ 65 (549)	1.42	1.18	1.70	0.000	1.49	1.23	1.80	0.000
CRT	≦64 (1269)	--	--	--	--	--	--	--	--
	≧ 65 (549)	1.67	1.40	2.02	0.000	1.72	1.41	2.10	0.000
SR	≦64 (1269)	0.83	0.73	0.93	0.002	0.83	0.73	0.93	0.002
	≧ 65 (549)	--	--	--	--	--	--	--	--
SLS	≦64 (1269)	--	--	--	--	--	--	--	--
	≧ 65 (549)	--	--	--	--	--	--	--	--
Female (n=2552)									
BMI	≦64 (1768)	1.70	1.53	1.90	0.000	1.71	1.53	1.90	0.000
	≧ 65 (784)	1.24	1.07	1.44	0.004	1.23	1.06	1.43	0.008
RHR	≦64 (1768)	1.38	1.24	1.54	0.000	1.39	1.25	1.55	0.000
	≧ 65 (784)	1.39	1.18	1.64	0.000	1.40	1.18	1.65	0.000
VC	≦64 (1768)	--	--	--	--	--	--	--	--
	≧ 65 (784)	--	--	--	--	--	--	--	--
HGS	≦64 (1768)	1.26	1.14	1.40	0.000	1.29	1.16	1.43	0.000
	≧ 65 (784)	--	--	--	--	--	--	--	--
CRT	≦64 (1768)	--	--	--	--	--	--	--	--
	≧ 65 (784)	1.23	1.06	1.42	0.000	1.22	1.05	1.41	0.009
SR	≦64 (1768)	0.86	0.78	0.96	0.004	0.86	0.78	0.95	0.003
	≧ 65 (784)	--	--	--	--	--	--	--	--
SLS	≦64 (1768)	--	--	--	--	--	--	--	--
	≧ 65 (784)	--	--	--	--	--	--	--	--

BMI = body mass index (kg/m2); RHR = resting heart rate; VC = vital capacity; HGS = handgrip strength; SR = sit and reach; SLS = single - leg standing with eyes closed; CRT = choice reaction time.

5. Discussion

To understand the incidence of hypertension in middle-aged and elderly people, analyze the physical characteristics of different blood pressure levels by age or sex, and understand the cognition of hypertension exercise prescription for implementation of self-care practice, so as to provide scientific basis for the formulation of targeted exercise intervention countermeasures. In our findings,the HGS are always a risking factor except for ≧ 65 category in female which is completely contrary to that of previous studies (Flint et al., 2019; Xiaolong et al., 2022).

Flexibility and balance can prevent worsening of physical fitness in elderly individuals (Garber et al., 2011). Our findings are partly consistent with them that in ≦ 64 category that the SR are significantly protective factors without SLS.

6. Conclusions

Increased BMI and RHR are always risking factors for hypertension. Significant positive associations were detected between the HGS and the incident risk of hypertension among males and the elderly female. The SR are significantly protective factors of hypertension among the middle aged. The VC is a protective factor for hypertension in older adults. Significant positive associations were detected between the CRT and the incident risk of hypertension among the elderly people. The risk of hypertension in the elderly is accompanied by a physical decline, but not in the middle-aged. These findings suggested that such factors should be considered when planning comprehensive assessments of the physical fitness impact on hypertension.

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