·临床研究·

老年人群体质量指数与高血压的相关性

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【摘 要】 **目的** 调查分析福州市健康体检的老年人体质量指数(BMI)与血压水平及高血压患病率的关系。**方法** 收集2016年1月至12月期间福建省立医院≥60岁的老年人健康体检的资料,回顾性分析该人群血压水平及高血压、超重或肥胖的患病率;按BMI分层,评价不同BMI类型人群的血压水平和高血压发病率。采用SPSS 11.7统计软件进行数据分析,根据数据类型,组间比较采用非配对资料 t 检验或 χ^2 检验。采用多因素logistic回归分析高血压的影响因素,采用受试者工作特征(ROC)曲线分析BMI与高血压风险的相关性。**结果** 在资料完整的1659例体检者中,高血压患病率为34.2%(568/1659),其中男性患病率为36.2%(363/1003),女性患病率为31.2%(205/656);该人群超重或肥胖患病率为48.1%(798/1659),其中男性患病率为48.4%(485/1003),女性患病率为47.7%(313/656);随着BMI增加,收缩压、舒张压及高血压患病率逐渐增高(BMI<18.5,18.5~23.9,24.0~27.9,≥28.0 kg/m^{2}组的高血压患病率分别为17.0%,27.4%,40.4%,55.5%)。多因素logistic回归分析发现超重或肥胖、空腹血糖高、高尿酸和高甘油三酯血症是高血压的危险因素。高血压风险相关ROC曲线显示,对收缩压性高血压风险,男性BMI的ROC曲线下面积(AUC)最大值为0.601(切点为25.55 kg/m^2),女性BMI的AUC最大值为0.609(切点为25.85 kg/m^2);对舒张性高血压风险,男性BMI的AUC最大值为0.665(切点为25.55 kg/m^2),女性BMI的AUC最大值为0.609(切点为26.35 kg/m^2)。**结论** 随着BMI的增加,收缩压、舒张压及高血压患病率逐渐增高。超重或肥胖、空腹血糖高、高尿酸和高三酰甘油血症是高血压的危险因素,BMI对预测高血压风险有一定价值。

【关键词】 老年人;高血压;肥胖;体质量指数
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Correlation between body mass index and hypertension in the elderly

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【Abstract】 **Objective** To investigate the relationship between body mass index (BMI) and hypertension among the elderly based on physical examination results in Fuzhou City. **Methods** Physical examination data of the inviduals over 60 years old who took the examination in our hospital from January to December 2016 were collected and retrospectively analyzed for blood pressure level and the incidences of hypertension, overweight or obesity. Based on BMI stratification, blood pressure levels and incidence of hypertension were evaluated in different BMI-level groups. SPSS statistics 11.7 was adopted for data processing. Unpaired t test or Chi-square test was employed for different data types. Multivariate logistic regression analysis was used to analyze the influencing factors of hypertension, and receiver operating characteristic (ROC) curve was adopted to analyze the correlation of BMI and risk of hypertension. **Results** In the 1659 enrolled subjects with complete data of physical examination, the incidence of hypertension was 34.2% (568/1659), with that of males accounting for 36.2% (363/1003) and females for 31.2 % (205/656). In the cohort, 48.1% (798/1659) of them were overweight or obese, and the ratio was 48.4% (485/1003) in the males and 47.7% (313/656) in the females. With the increase of BMI, the levels of systolic (SBP) and diastolic blood pressures (DBP) and incidence of hypertension were gradually elevated (for BMI<18.5, 18.5 - <23.9, 24.0 - 27.9, ≥28.0 kg/m^2, the incidence of hypertension was 17.0%, 27.4%, 40.4% and 55.5%, respectively). Multivariate logistic regression analysis found that overweight or obesity, high fasting blood glucose, high uric acid and hypertriglyceridemia were risk factors for hypertension. ROC curves analysis related to hypertension risk showed that the area under ROC curve (AUC) of male BMI was 0.601 (cut-off point = 25.55 kg/m^2) and that of female BMI was 0.609 (cut-off point = 25.85 kg/m^2) in the risk of systolic hypertension; for the risk of diastolic hypertension, the AUC was 0.665 for the male BMI (cut-off point = 25.55 kg/m^2) and 0.609 for female BMI (cut-off point = 26.35 kg/m^2). **Conclusion** The SBP and

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DBP levels and hypertension incidence are gradually increased with the increase of BMI level. Overweight or obesity, high fasting blood glucose, high uric acid and hypertriglyceridemia are risk factors for hypertension. BMI shows predictive value of hypertension risk.

【Key words】 aged; hypertension; obesity; body mass index

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随着社会经济发展和人们生活水平的提高,老龄化已成为全球化趋势。高血压是老年人群常见心血管疾病之一,是全球范围内的重大健康问题。降低高血压患者的血压水平可明显减少心脑血管疾病和肾病事件的发生。老年高血压患者同时伴有肥胖或超重的比例正以惊人的速度逐年上升。体质量指数(body mass index,BMI)是目前临床上判断超重和肥胖的最常用标准。BMI 超标的问题在我国也正在呈现上升的态势[1,2]。本研究拟探讨福州市≥60 岁健康体检老年人群血压与 BMI 分布特点的关系及 BMI 与高血压风险的相关意义,以便有针对性地提高老年人群对高血压和肥胖的认知和防治水平。

1 对象与方法

1.1 研究对象

2016 年 1 月至 12 月在福建省立医院进行健康体检的所有≥60 岁人群均为福州市企事业单位工作人员(包括离退休),其中资料完整的 1659 人,年龄 60 ~ 91(67.2 ± 6.2)岁,男性 1003 人(占 60.4%),女性 656 人(占 40.6%)。重复体检者仅记录第 1 次检查结果。按照 BMI 将研究对象分为 4 组[3]:BMI < 18.5 kg/m^2 组、18.5 kg/m^2 ≤ BMI < 23.9 kg/m^2 组、24.0 kg/m^2 ≤ BMI < 27.9 kg/m^2 组和 BMI≥28.0 kg/m^2 组。

1.2 方法

采集空腹肘静脉血,采用罗氏全自动生化分析仪检测空腹血糖、血脂四项等生化指标。由经过统一培训的我院医师进行资料收集,内容包括:年龄、性别、收缩压(systolic blood pressure,SBP)、舒张压(diastolic blood pressure,DBP)、身高、体质量、BMI、血尿酸(uric acid,UA)、血肌酐(serum creatinine,SCr)、血尿素氮(blood urea nitrogen,BUN)、空腹血糖(fasting plasma glucose,FPG)、总胆固醇(total cholesterol,TC)、甘油三酯(triglycerides,TG)、高密度脂蛋白胆固醇(high-density lipoprotein cholesterol,HDL-C)及低密度脂蛋白胆固醇(low-density lipoprotein cholesterol,LDL-C)。

1.3 诊断标准

高血压:在未服用降压药物情况下,非同日和(或)连续 3 次血压测量平均 SBP ≥ 140 mmHg(1 mmHg = 0.133 kPa)和(或)DBP ≥ 90 mmHg,诊断为高血压;或患者既往有高血压史,目前正在服用降压药物,虽然血压 < 140/90 mmHg,也诊断为高血压[4];排除继发性高血压(如肾上腺疾病、肾动脉狭窄等)。

高血糖:FPG ≥ 6.1 mmol/L,餐后 2 小时血糖 ≥ 11.1 mmol/L 和(或)已确诊糖尿病[5]。

血脂异常:(1)TG ≥ 2.26 mmol/L 为高 TG 血症;(2)TC ≥ 6.22 mmol/L 为高胆固醇血症;(3)LDL-C ≥ 4.14 mmol/L 为高 LDL-C 血症;(4)HDL-C < 1.04 mmol/L 为低 HDL-C 血症[6]。

高 UA 血症:男性 UA ≥ 420 μmol/L,女性 UA ≥ 360 μmol/L,诊断基于单次检查。

1.4 统计学处理

采用 SPSS 11.7 软件进行分析。计量资料用均数 ± 标准差($\bar{x} \pm s$)表示,2 组之间的比较采用非配对资料 t 检验;计数资料以百分率表示,组间比较用 χ^2 检验;高血压相关危险因素的分析采用二分类非条件 logistic 回归分析,参与分析的变量包括超重或肥胖、年龄、性别、高 FPG、高 UA、高 TG、高 TC、高 LDL-C 和低 HDL-C;BMI 与高血压风险相关性采用受试者工作特征(receiver operating characteristic,ROC)曲线分析。P < 0.05 为差异有统计学意义。

2 结 果

2.1 不同性别人群间资料比较

男性和女性间高血压患病率以及超重或肥胖患病率差异无统计学意义(P > 0.05)。与男性相比,女性的 UA、SCr 和 BUN 显著降低,而 TC、LDL-C 和 HDL-C 显著增加,差异具有统计学意义(P < 0.05;表 1)。

2.2 按 BMI 分层不同性别人群血压水平及高血压患病率比较

按 BMI 分层后,男性和女性的 SBP、DBP 及高血压患病率均随着 BMI 的增高逐渐增高,差异均具有统计学意义(P < 0.05;表 2)。

2.3 高血压相关危险因素分析

以高血压为因变量,以性别、年龄、超重或肥胖、高 UA、低 HDL-C、高 LDL-C、高 TC、高 FPG、高 TG 为协变量进行非条件 logistic 回归,协变量引入和删除的概率标准分别设定为 0.05 和 0.10,经多因素回归

表1 不同性别人群间资料比较

Table 1 Comparison of data between males and females

Item	Male (n=1003)	Female (n=656)
Age(years, $\bar{x}\pm s$)	67.6±0.2	66.6±0.3
SBP(mmHg, $\bar{x}\pm s$)	130.09±0.77	130.20±0.97
DBP(mmHg, $\bar{x}\pm s$)	79.47±0.42	78.64±0.51
BMI(kg/m^2, $\bar{x}\pm s$)	24.19±0.11	24.27±0.16
UA(μmol/L, $\bar{x}\pm s$)	379.01±2.95	312.54±3.23*
SCr(μmol/L, $\bar{x}\pm s$)	75.75±0.48	56.50±0.50*
BUN(mmol/L, $\bar{x}\pm s$)	5.15±0.05	4.95±0.05*
Hypertension[n(%)]	363(36.2)	205(31.3)
Overweight or obesity[n(%)]	485(48.4)	313(47.7)
FPG(mmo/L, $\bar{x}\pm s$)	5.60±0.06	5.59±0.06
TC(mmo/L, $\bar{x}\pm s$)	4.98±0.03	5.50±0.04*
TG(mmol/L, $\bar{x}\pm s$)	1.65±0.05	1.66±0.05
LDL-C(mmol/L, $\bar{x}\pm s$)	2.93±0.03	3.18±0.04*
HDL-C(mmol/L, $\bar{x}\pm s$)	1.29±0.01	1.50±0.01*

SBP: systolic blood pressure; DBP: diastolic blood pressure; BMI: body mass index; UA: uric acid; SCr: serum creatinine; BUN: blood urea nitrogen; FPG: fasting plasma glucose; TC: total cholesterol; TG: triglycerides; LDL-C: low-density lipoprotein cholesterol; HDL-C: high-density lipoprotein cholesterol. 1 mmHg = 0.133 kPa. Compared with male, *P<0.01

分析,超重或肥胖、高FPG、高UA、高TG血症和低HDL-C是高血压的独立危险因素(P<0.05;表3)。

2.4 BMI与不同性别高血压风险的ROC曲线分析

ROC曲线结果显示,BMI对男女的SBP、DBP是否存在血压高风险具有一定的相关价值(表4)。在SBP高血压风险中,男性BMI的ROC曲线下面积(area under ROC curve,AUC)最大值为0.601(切点为25.55 kg/m^2,灵敏度为41.7%,特异度为72.0%),女性BMI的AUC最大值为0.609(切点为25.85 kg/m^2,灵敏度为41.3%,特异度为75.3%);在DBP高血压风险中,男性BMI的AUC最大值为0.665(切点为25.55 kg/m^2,灵敏度为53.1%,特异度为72.7%),女性BMI的AUC最大值为0.609(切点为26.35 kg/m^2,灵敏度为35.4%,特异度为77.5%)。

3 讨 论

人口老龄化已经成为全球范围内需要面对的社会问题,而老年人容易合并多种疾病已是共识。高血压是一种可以导致心、脑、肾等重要器官严重损害的常见病和多发病。国内外实践证明,降低高血压患者的血压水平,可明显减少脑卒中、心脏病及肾病的发生[4,7]。在美国≥60岁人群中,高血压患病率为66.7%[8];而在我国最近一次的全国性高血压患病率调查显示,该年龄人群高血压患病率接近50%[9]。本次调查研究的健康体检老年人群高血压的患病率34.2%,由于该人群教育素质水平相对较高,生活习惯及环境相对较好,可能导致该人群高血压患病率较全国性高血压患病率降低。

高血压的主要病因是遗传因素和外界环境因素。有研究证实肥胖与高血压密切相关,肥胖者易患高血压,BMI > 24 kg/m^2 者患高血压的危险是BMI正常者的3~4倍,超重的程度与高血压的发生也有关系,体质量越大,患高血压的危险越大[10]。本研究发现,该人群在BMI分层后,低体重组、正常体重组、超重组和肥胖组的SBP水平分别为(123.11±2.77)、(126.42±0.89)、(132.71±0.91)、(136.94±1.92) mmHg,DBP水平分别为(71.89±1.59)、(76.85±0.45)、(80.58±0.49)、(84.83±1.02) mmHg,表明随着BMI增高,老年人群SBP及DBP呈增高趋势。同时男女分层后的血压水平变化趋势也是一致。

表2 不同BMI分层人群血压水平及高血压患病率

Table 2 Comparison of blood pressure and hypertension prevalence among different populations stratified by BMI

BMI	n	SBP (mmHg, $\bar{x}\pm s$)	DBP (mmHg, $\bar{x}\pm s$)	Hypertension [n(%)]
<18.5 kg/m^2				
Male	196	122.43±4.07	73.57±2.26	42(21.4)
Female	133	124.11±3.84	69.42±1.86	14(10.5)
18.5–23.9 kg/m^2				
Male	322	126.39±1.13*	76.94±0.58*	89(27.6)*
Female	210	126.42±1.43*	76.68±0.73*	57(27.1)*
24.0–27.9 kg/m^2				
Male	313	132.54±1.14*#	80.55±0.63*#	128(40.8)*#
Female	197	133.00±1.51*#	80.64±0.82*#	78(39.6)*#
≥28.0 kg/m^2				
Male	172	137.41±2.53*#△	86.79±1.41*#△	104(60.5)*#△
Female	116	136.26±2.98*#△	81.93±1.33*#△	56(48.3)*#△

BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure. 1 mmHg = 0.133 kPa. Compared with BMI < 18.5 kg/m^2, *P<0.05; compared with BMI 18.5–23.9 kg/m^2, #P<0.05; compared with BMI 24.0–27.9 kg/m^2, △P<0.05

表 3 高血压相关因素的多因素 logistic 回归分析

Table 3 Multivariate logistic regression analysis of hypertension-related factors

Factor	*B*	*SE*	*Wald*	*OR*(95% *CI*)	*P* value
Overweight or obesity	0.649	0.128	25.912	1.914(1.491 – 2.457)	0.000
Age	0.017	0.010	2.864	1.017(0.997 – 1.037)	0.091
Male	– 0.179	0.130	1.906	0.863(0.649 – 1.078)	0.167
High FPG	0.460	0.151	9.242	1.584(1.177 – 2.130)	0.002
High UA	0.171	0.140	1.493	1.187(0.902 – 1.562)	0.022
High TC	– 0.039	0.229	0.028	0.962(0.614 – 1.507)	0.866
High TG	0.290	0.169	2.950	1.336(0.960 – 1.859)	0.026
Low HDL-C	– 0.391	0.197	3.935	0.676(0.459 – 0.995)	0.047
High LDL-C	0.086	0.277	0.097	1.090(0.633 – 1.877)	0.755

FPG: fasting plasma glucose; UA: uric acid; TC: total cholesterol; TG: triglycerides; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol

表 4 不同性别 BMI 指标与高血压风险相关的 ROC 曲线分析

Table 4 AUC for BMI indicators associated with risk of hypertension between different genders

Related indicator	BMI cut-off point	Youden index	Sensitivity	Specificity	AUC	95% *CI*	*P* value
Male							
Systolic hypertension	25.55	0.137	0.417	0.720	0.601	0.558 – 0.644	0.000
Diastolic hypertension	25.55	0.258	0.531	0.727	0.665	0.616 – 0.715	0.000
Hypertension	25.55	0.185	0.441	0.744	0.623	0.582 – 0.665	0.000
Female							
Systolic hypertension	25.85	0.166	0.413	0.753	0.609	0.555 – 0.633	0.000
Diastolic hypertension	26.35	0.129	0.354	0.775	0.609	0.547 – 0.671	0.000
Hypertension	25.75	0.135	0.400	0.735	0.604	0.552 – 0.657	0.000

BMI: body mass index; ROC: receiver operating characteristic; AUC: area under ROC curve

本次调查结果显示,福州市健康体检老年人群超重或肥胖患病率 48.1%,该患病率明显高于 2010 年我国成年人超重率和肥胖率,分别达 30.6% 和 12.0%[11]。国外最新研究证实,随着 BMI 的增加,高血压患病率呈现上升趋势[12,13]。本研究中,低体重组、正常体重组、超重组和肥胖组高血压检出率分别为 17.0%、27.4%、40.4% 和 55.5%,表明随着 BMI 增高,老年人群高血压患病率呈现增高趋势。同时男女各分层高血压患病率变化趋势一致,与国内外报道相一致[12-14]。

目前国内尚未有研究报道健康体检老年人 BMI 的 ROC 曲线切点与高血压风险相关性的分析。本研究在使用 BMI 指标对健康体检老年人群高血压患病风险的相关分析发现,男性和女性 AUC 均 <0.7,但亦 >0.5(均 $P<0.05$),均对高血压风险具有一定相关价值。对相关舒张性高血压风险,男性 AUC 最大值为 0.665(切点为 25.55 kg/m^2),具有相关意义,其灵敏度为 53.1%,特异度为 72.7%;对相关收缩性高血压风险,女性 AUC 最大值为 0.609(切点为 25.85 kg/m^2),其灵敏度为 41.3%,特异度为 75.3%。

BMI 与高血压发病相关的可能机制:肥胖者分泌更多的瘦素,瘦素通过改变肾钠通道、刺激肾素 – 血管紧张素和交感神经系统、以及与胰岛素及促炎因子相互作用等途径导致高血压的发生[15]。另外,超重或肥胖者经常存在细胞的跨膜转运功能障碍,$Na^+ – K^+$ – 三磷酸腺苷(adenosine triphosphate, ATP)酶活性降低,细胞内外 $Na^+ – K^+$ 泵交换受到抑制,促进 $Na^+ – Ca^{2+}$ 交换,进而使 Ca^{2+} 内流增加,引起血管收缩,血压上升[16,17]。此外,超重或肥胖的老年人还经常具有高血压发病的其他危险因素,如摄入过量的不健康食品、体力活动过少、血脂异常等。

本研究发现,老年人群随着 BMI 的增加,高血压患病率及血压水平呈上升趋势,且多因素 logistic 回归分析结果表明,超重或肥胖是高血压的危险因素;BMI 对高血压患病风险具有一定预测意义,说明肥胖在高血压防控中起着重要作用,通过干预,降低或控制体质量可预防和控制高血压的发病风险。

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