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在线全文

西藏地区藏族人群单纯舒张期高血压的患病现状及其影响因素分析*

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【摘要】 目的 调查西藏地区藏族人群单纯舒张期高血压（isolated diastolic hypertension, IDH）的患病率并分析其影响因素，为高原地区高血压等相关疾病防控提供一定的证据。**方法** 采用多阶段分层整群随机抽样方法，2020年6月－2023年8月对西藏阿里地区、那曲市、山南市和拉萨市世居藏族居民进行问卷调查，共纳入3 918名数据完整的18～80岁藏族居民为调查对象，收集调查对象的人口学相关信息、生活习惯和慢性病患病情况等资料，并采集空腹静脉血等进行血常规和血生化检测。分析不同特征人群的IDH患病情况，多因素logistic回归分析其患病影响因素，受试者工作特征（receiver operating characteristic, ROC）曲线分析影响因素对IDH患病率的预测价值，并将其与既往IDH预测模型进行比较。**结果** 调查人群高血压患病率33.7%（1 321人），其中IDH 395人，占高血压患者的29.9%。多因素回归分析结果显示，年龄、心率、体重指数、腰围、血红蛋白、低密度脂蛋白胆固醇与IDH患病风险相关（P<0.05）。ROC曲线下面积（area under the curve, *AUC*）为0.71，相比于既往IDH预测模型，更能准确预测IDH的风险。其中，BMI对IDH患病风险预测度最高。**结论** 西藏地区藏族人群IDH患病率较高，需合理分配卫生资源。相比于既往IDH预测模型，本研究模型更适用于藏族人群，对中青年、超重肥胖、中心性肥胖、高原红细胞增多症、血脂异常等高危人群进针对性干预，有效控制IDH的发生发展。

【关键词】 单纯舒张期高血压 影响因素 藏族人群 西藏地区

Prevalence and Influencing Factors of Isolated Diastolic Hypertension in Tibetan Population in Tibet

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【Abstract】 Objective To investigate the prevalence and influencing factors of isolated diastolic hypertension (IDH) in the Tibetan population in Tibet and to provide some evidence for the prevention and control of hypertension and other related diseases in high-altitude areas. **Methods** A multistage stratified whole-group random sampling method was used to enroll participants from Ngari Prefecture, Nagqu City, Shannan City, and Lhasa City, Tibet. A total of 3 918 native Tibetans with complete data were enrolled in the survey between June 2020 and August 2023. The participants were aged from 18 to 80. The demographic data, life habits, and chronic disease prevalence of the participants were collected. Fasting venous blood samples were collected to perform the routine blood tests and blood biochemistry tests. The prevalence of IDH in subgroups with different characteristics was analyzed and the influencing factors were analyzed by multivariate logistic regression, accordingly. The predictive value of influencing factors on the prevalence of IDH was analyzed by the receiver operating characteristic (ROC) curve and the findings were compared with those of the previous prediction models for IDH. **Results** The prevalence of hypertension in the participants was 33.7% (n=1 321), among which, 395 had IDH, accounting for 29.9% of the hypertensive patients. The results of multivariate regression showed that age, heart rate, body mass index, waist circumference, hemoglobin, and low-density lipoprotein cholesterol were associated with risks of developing IDH (P<0.05). The area under the ROC curve (*AUC*) was 0.71, which indicated improved accuracy for predicting the risks for IDH in comparison with previous predictive models for IDH. Among the influencing factors, BMI showed the best predictive value for IDH risks. **Conclusion** The prevalence of IDH is high among Tibetans in Tibet, suggesting the necessity for rational allocation of health resources in accordance. Compared with the previous IDH prediction models, the model proposed in this study is more suited for the Tibetan population. Targeted interventions should be carried out for the high-risk populations, such as young and middle-aged adults and populations suffering from overweight/obesity, central obesity, high-altitude polycythemia, and dyslipidemia, so as to effectively control the occurrence and development of IDH.

【Key words】 Isolated diastolic hypertension Influencing factors Tibetan population Tibet

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2021年《中国心血管健康与疾病报告》中, 心血管疾病位于城乡居民死亡原因首位, 其中高血压人群占主导地位[1]。作为高血压的亚型之一, 单纯舒张期高血压(isolated diastolic hypertension, IDH)在原发性高血压中占比较少[2], 但与中风、心脏病和其他高血压后遗症的风险独立相关, 使得发生心血管事件的风险明显升高[3-5]。每10 mmHg(1 mmHg=0.133 kPa)的常见舒张压(diastolic blood pressure, DBP)差异与卒中死亡风险增加两倍以上相关[6]。因患病人群多为青年人, 易被忽视。一项百万人项目研究[7]报告86.1%的IDH患者未经治疗, 且大部分治疗患者管理不善。随着年龄增长, 病程延长, 多数不加干预的IDH可进展为单纯收缩期高血压(isolated systolic hypertension, ISH)和收缩期-舒张期高血压(systolic-diastolic hypertension, SDH)[8]。

在高海拔、缺氧、低气压、独特地理环境及特有生活饮食习惯等多种因素的影响下, 西藏地区高血压患病率较平原地区更高[9-11]。血压的升高与血流动力学和血管结构异常有关, 尤其是长期在高原地区低氧刺激下[12]。现有研究多针对平原地区高血压开展研究, 鲜少有关西藏高原地区不同亚型高血压流行病学调查数据, 更少有关高海拔地区特有的环境及慢性病的IDH患病预测模型。基于此, 本研究在西藏地区海拔3 000 m以上的成年世居藏族居民中开展调查, 旨在了解西藏地区不同亚型高血压患病情况和风险因素, 并探讨相关因素对IDH患病的预测价值, 为临床医疗、人群防治及基础研究提供参考依据。

1　资料与方法

1.1　一般资料

2020年6月–2023年8月采用分层整群随机抽样的方法, 在西藏阿里地区、那曲市、山南市和拉萨市, 根据区县人口比例, 抽取样本区县, 在每个区县中抽取2 ~ 3个自然村落的世居藏族居民为调查对象。纳入标准: 年龄18 ~ 80岁、居住6个月以上的世居藏族居民。排除标准: 年龄<18岁或>80岁、继发性高血压、严重心脑血管疾病、严重肝肾功能不全、精神疾病患者、孕妇、资料缺失、自愿退出研究者。本研究经西藏大学医学伦理学委员会批准, 所有调查对象均已签署知情同意书。

1.2　方法

1.2.1　问卷调查

本次研究依托中央支持地方高校改革发展专项资金项目开展问卷调查。调查内容包括人口学信息、生活方式、慢性病状况等。根据预调查结果对问卷进行修正后开展调查。调查员均为藏族, 经专业培训后, 与调查对象面对面进行访谈。

1.2.2　血压测定

室内静坐休息15 min后, 用欧姆龙医用型电子血压计(HEM-907)连续测量右上肢肱动脉血压3次后, 取其均值。

1.2.3　血常规和血生化指标

血生化检测: 空腹12 h后由医护人员严格按照无菌操作抽取外周静脉血5 mL, 静置2 h后分离血清, 使用全自动生化分析仪(日立7600型)测量血脂全套、空腹血糖(fasting blood glucose, FBG)、血尿酸(uric acid, UA)、同型半胱氨酸(homocysteine, Hcy)等指标。血常规检测: 空腹12 h后采集静脉血2 mL至乙二胺四乙酸二钾抗凝管, 使用迈瑞-BC3000plus血球分析仪进行血常规分析。检测期间严格执行医院室内质量控制, 保证结果的准确性和稳定性。

1.2.4　高血压诊断标准

收缩压(systolic blood pressure, SBP)<140 mmHg且舒张压(diastolic blood pressure, DBP)≥90 mmHg诊断为IDH; SBP≥140 mmHg且DBP<90 mmHg诊断为ISH; SBP≥140 mmHg且DBP≥90 mmHg诊断为SDH; 控制高血压为既往诊断高血压, 正服用降压药, 且SBP<140 mmHg和DBP<90 mmHg[13]。

1.3　统计学方法

采用SPSS 26.0和MedCalc进行数据的统计学处理分析。计数资料用频数和百分比描述, 计量资料用$\bar{x} \pm s$或中位数(四分位间距)描述, 采用卡方检验和Mann-Whitney检验进行组间分析; 采用多因素logistic逐步回归分析各指标与IDH患病率的关系, 然后将具有统计学意义的指标纳入受试者工作特征(the receiver operating characteristic, ROC)曲线分析, 以进一步分析影响因素对IDH患病率的预测价值。采用双侧检验, P<0.05为差异有统计学意义。

2　结果

2.1　基线特征

本次研究共纳入调查对象3 918名, 年龄18 ~ 80岁, 平均年龄(44.07±14.27)岁, 多为50岁以下的中青年人, 其中, 男性1 639人, 女性2 279人。文化程度较低, 多居住在农牧区, 平均居住海拔4 400 m以上。患高血压病1 321人(33.7%), 其中, IDH 395人(占高血压患者29.9%), ISH 124人(占高血压患者9.4%), SDH 586人(占高血压患者44.4%), 控制高血压216人(占高血压患者16.4%)。

2.2 不同亚型高血压患病者的人群特征

见表1。在总调查人群中,高血压患者和非高血压患者在海拔、气压、含氧量、性别比、年龄、教育、就业情况、婚姻状况、锻炼、吸烟、饮酒、高血压家族遗传史、心率、体重指数(body mass index, BMI)、腰围(waist circumference, WC)、血红蛋白(hemoglobin, HGB)、红细胞比容(red blood cell specific volume, HCT)、血UA、血清总胆固醇(total cholesterol, TC)、甘油三酯(triglycerides,

表 1 不同亚型高血压人群分布特征

Table 1 Demographic distribution characteristics of different subtypes of hypertension

Variable	No hypertension (*n*=2 597)	ISH (*n*=124)	IDH (*n*=395)	SDH (*n*=586)	Controlling hypertension (*n*=216)
Altitude/m	4 467.04±372.68	4 156.21±469.26	4 414.23±397.65	4 279.23±445.60	4 410.14±398.79
Pneumatic pressure/mmHg	50.80±4.20	54.38±5.31	51.40±4.50	52.96±5.07	51.45±4.51
Oxygen content/%	11.89±0.61	12.43±0.78	11.98±0.66	12.21±0.74	11.99±0.66
Sex/case (%)					
Men	1 032 (40)	46 (37)	200 (51)	263 (45)	98 (45)
Women	1 565 (60)	78 (63)	195 (49)	323 (55)	118 (55)
Age/yr.	39.72±12.62	57.29±13.61	46.72±12.31	57.33±11.73	47.96±13.91
Type of residence/case (%)					
Town	142 (6)	5 (4)	31 (8)	26 (4)	3 (2)
Rural/farming/stockbreeding	2 455 (94)	119 (96)	364 (92)	560 (96)	216 (98)
Education attainment/case (%)					
Illiterate	1 751 (67)	92 (74)	272 (69)	417 (71)	171 (79)
Primary school	415 (16)	28 (23)	67 (17)	142 (24)	27 (13)
Junior middle school or above	431 (17)	4 (3)	56 (14)	27 (5)	18 (8)
Employment status/case (%)					
Employed	471 (18)	10 (8)	84 (21)	75 (13)	17 (8)
Retired	40 (2)	6 (5)	8 (2)	13 (2)	9 (4)
Student	26 (1)	0	1 (1)	2 (1)	1 (1)
Unemployed	111 (4)	5 (4)	14 (3)	21 (4)	18 (8)
Farmers/herdsmen	1 949 (75)	103 (83)	288 (73)	475 (81)	171 (79)
Marital status/case (%)					
Single	350 (14)	8 (7)	26 (7)	43 (7)	10 (5)
Married	2 196 (85)	107 (86)	356 (90)	501 (86)	199 (92)
Other	51 (2)	9 (7)	13 (3)	42 (7)	7 (3)
Annual gross income/case (%)					
<12 000 yuan	690 (27)	41 (33)	95 (24)	175 (30)	67 (31)
12 000-19 999 yuan	865 (33)	41 (33)	129 (33)	181 (31)	83 (38)
20 000-59 999 yuan	881 (34)	40 (32)	139 (35)	211 (36)	54 (25)
60 000-99 999 yuan	63 (2)	0	13 (3)	10 (2)	5 (2)
100 000-190 000 yuan	70 (3)	1 (1)	13 (3)	6 (1)	1 (1)
>200 000 yuan	28 (1)	1 (1)	6 (2)	3 (1)	6 (3)
Poverty/case (%)					
No	1 872 (72)	99 (80)	300 (76)	449 (77)	149 (69)
Yes	725 (28)	25 (20)	95 (24)	137 (23)	67 (31)
Insurance/case (%)					
No	79 (3)	6 (5)	12 (3)	19 (3)	9 (4)
Yes	2 518 (97)	118 (95)	383 (97)	567 (97)	207 (96)
Exercise/case (%)					
Almost never	1 690 (65)	67 (54)	284 (72)	354 (60)	113 (52)
1-2 times/week	152 (6)	2 (2)	12 (3)	20 (3)	8 (4)
3-5 times/week	98 (4)	3 (2)	12 (3)	20 (3)	7 (3)
Almost daily	657 (25)	52 (42)	87 (22)	192 (33)	88 (41)

续表 1

Variable	No hypertension (*n*=2 597)	ISH (*n*=124)	IDH (*n*=395)	SDH (*n*=586)	Controlling hypertension (*n*=216)
Smoking/case (%)					
Smoking	245 (9)	8 (7)	43 (11)	35 (6)	20 (9)
Quit smoking	99 (4)	12 (10)	22 (6)	36 (6)	13 (6)
Non-smoking	2 252 (87)	104 (84)	330 (84)	514 (88)	183 (85)
Drinking/case (%)					
Drinking	314 (13)	19 (15)	62 (16)	79 (14)	25 (12)
Quit drinking	83 (3)	12 (10)	13 (3)	25 (4)	11 (5)
Non-drinking	2 199 (85)	93 (75)	320 (81)	482 (82)	180 (83)
Family history of hypertension/case (%)					
No	2 391 (92)	115 (93)	361 (91)	514 (88)	197 (91)
Yes	206 (8)	9 (7)	34 (9)	72 (12)	19 (9)
Diabetes/case (%)					
No	2 515 (97)	114 (92)	374 (95)	539 (92)	198 (92)
Yes	82 (3)	10 (8)	21 (5)	47 (8)	18 (8)
Heart rate/min^{-1}	75.50±11.77	71.66±12.80	79.01±13.44	76.14±11.93	75.82±12.14
SBP/mmHg	111.68±22.49	148.90±9.48	129.06±7.76	160.94±17.28	116.42±12.82
DBP/mmHg	74.22±8.43	83.51±5.88	94.58±5.10	103.55±9.39	77.15±8.14
BMI/(kg/m^2)	23.60±2.58	25.48±2.92	26.31±8.28	26.45±3.57	24.28±2.40
WC/cm	81.34±9.98	88.27±8.45	89.07±11.32	90.63±9.64	85.02±10.06
RBC/($\times10^{12}L^{-1}$)	5.52±1.26	5.32±0.76	5.65±0.82	5.43±0.86	5.64±0.77
HGB/(g/L)	166.51±26.53	160.49±26.61	175.09±28.46	165.39±30.13	169.49±28.50
HCT	11.01±21.68	2.98±11.13	11.52±23.22	8.30±19.85	7.10±18.23
TC/(mmol/L)	5.33±1.87	5.43±1.68	5.72±1.62	5.90±3.29	5.50±1.77
TG/(mmol/L)	0.98±0.70	1.28±0.93	1.29±0.92	1.32±0.82	1.09±0.74
HDL-C/(mmol/L)	1.66±0.61	1.70±0.69	1.60±0.50	1.62±0.57	1.66±0.65
LDL-C/(mmol/L)	2.66±1.00	2.90±1.07	3.08±1.04	3.11±1.07	2.80±1.14
UA/(μmol/L)	358.33±127.91	348.15±116.03	407.94±143.13	376.97±136.10	378.61±129.32
FBG/(mmol/L)	4.47±0.89	4.75±1.03	4.79±1.31	4.83±1.13	4.63±1.08
Hcy/(μmol/L)	20.36±10.33	21.4±1.03	22.31±11.08	22.45±11.23	20.33±8.43

IDH: isolated diastolic hypertension; ISH: isolated systolic hypertension; SDH: systolic-diastolic hypertension; BMI: body mass index; WC: waist circumference; UA: uric acid; FBG: fasting blood glucose; Hcy: homocysteine; TC: total cholesterol; TG: triglycerides; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol; RBC: red blood cell; HGB: hemoglobin; HCT: hematocrit, or red blood cell-specific volume. 1 mmHg=0.133 kPa.

TG)、低密度脂蛋白胆固醇(low-density lipoprotein cholesterol, LDL-C)、Hcy、FBG等方面差异有统计学意义(P<0.05); 在不同亚型高血压患者中, IDH患者的性别比、年龄、居住地、锻炼、心率、SBP、DBP、BMI、WC、RBC、HGB、UA、TC、TG、HDL-C、LDL-C、Hcy、FBG与其他高血压亚型患者不同(P<0.05)。

2.3　IDH患病者的影响因素分析

多因素logistic回归分析结果表明, 与非IDH相比, 年龄、心率、BMI、WC、HGB、LDL-C与IDH患病风险相关(P<0.05), 见表2。

表 2　IDH患病率的多因素回归分析

Table 2　Multivariate regression of the prevalence of IDH

Variable	*B*	*SE*	Wald	*OR* (95% *CI*)	*P*
Age	0.01	0.00	5.63	1.02 (1.00, 1.02)	0.01
Heart rate/min^{-1}	0.02	0.00	27.19	1.11 (1.02, 1.03)	<0.01
BMI/(kg/m^2)	0.10	0.02	26.22	1.10 (1.07, 1.12)	<0.01
WC/cm	0.02	0.01	14.19	1.02 (1.01, 1.04)	<0.01
HGB/(g/L)	0.01	0.00	10.51	1.01 (1.00, 1.01)	<0.01
LDL-C/(mmol/L)	0.14	0.05	6.94	1.15 (1.04, 1.28)	0.01

B: unstandardized beta coefficient; *CI*: confidence interval; *SE*: standard error; *OR*: odds ratio. The abbreviations are explained in the note to Table 1.

2.4　IDH的预测模型

进一步评估影响因素对IDH患病的预测价值。在IDH患病预测模型中, ROC曲线下面积(the area under the curve, *AUC*)为0.71, 年龄、心率、BMI、WC、HGB和LDL-C均可以预测IDH的患病风险, 心率、BMI、WC、HGB和LDL-C的临界值分别为77 min^{-1}、23.99 kg/m^2、83.61 cm、

174.50 g/L和2.82 mmol/L, 见表3。与纳入传统危险因素预测模型的ROC曲线比较, 结果显示两模型的预测能力相近(P=0.73); 与既往Framingham研究预测模型[14]相比, 差异有统计学意义(P=0.03), 提示本研究预测模型有所改善。见表4。

表 3 ROC曲线结果

Table 3 ROC curve results

Variable	*AUC*	95% *CI*	*P*
Age	0.57	0.54, 0.60	<0.01
Heart rate	0.57	0.54, 0.61	<0.01
BMI	0.69	0.67, 0.72	<0.01
WC	0.65	0.63, 0.68	<0.01
HGB	0.59	0.56, 0.62	<0.01
LDL-C	0.60	0.57, 0.63	<0.01
Predictive model 1	0.71	0.69, 0.74	<0.01
Predictive model 2	0.71	0.69, 0.74	<0.01
Predictive model 3	0.69	0.66, 0.72	<0.01

Predictive model 1: age, heart rate, BMI, WC, HGB, and LDL-C; predictive model 2: age, heart rate, BMI, WC, HGB, LDL-C, and traditional risk factors (smoking, drinking, family history of hypertension, etc.); predictive model 3: Framingham Heart Study IDH predictive models.

表 4 ROC曲线比较结果

Table 4 Comparison results of ROC curves

Variable	*Z*	95% *CI*	*P*
Predictive model 1 vs. Predictive model 2	0.35	0.00, 0.01	0.73
Predictive model 1 vs. Predictive model 3	2.11	0.01, 0.04	0.03
Predictive model 2 vs. Predictive model 3	2.14	0.01, 0.04	0.03

Predictive model 1: age, heart rate, BMI, WC, HGB, and LDL-C; predictive model 2: age, heart rate, BMI, WC, HGB, LDL-C, and traditional risk factors (smoking, drinking, family history of hypertension, etc.); predictive model 3: Framingham Heart Study IDH predictive models.

3 讨论

本研究结果显示, 西藏地区藏族人群高血压患病率33.7%, 控制率16.4%, 高于近几年全国成年人调查高血压控制率(8.5%~15.3%)[15], 较2013年西藏自治区成年居民患病率和控制率有所改善[16], 说明西藏地区的血压控制水平在未来可进一步降低。不同亚型上, IDH患病率为10.1%, ISH患病率为3.2%, SDH患病率为14.9%, 高血压人群以IDH(29.9%)和SDH(44.4%)为主, 高于东北居民(6.1%)[17], 提示西藏地区世居藏族居民舒张期高血压高发情况不容乐观。本研究55岁以上和55岁以下的高血压人群均以IDH和SDH为主, 与既往相关研究报道不同。其一, 可能与样本人群、地区差异、膳食生活方式等有关。其二, 有研究认为IDH是高血压的早期阶段, 其预后较好, 发生脑卒中的风险也最低, 但控制率较低, 易发展为SDH[14]。此外, 西藏地区长期低氧刺激交感神经兴奋致使血管收缩, 肾素-血管紧张素-醛固酮系统激活, 导致血压升高[18-19], 带来心脏、大脑以及肾脏等多种器官的损害都是不可逆的。这提示西藏地区应合理分配医疗资源, 降低IDH患病率, 控制其进一步发展。

多因素logistic回归分析结果显示, 年龄、心率、BMI、WC、HGB、LDL-C是IDH的风险因素。Framingham研究连续10年的随访显示, 青年男性、肥胖、睡眠呼吸障碍者, 以及有吸烟、酗酒、缺乏锻炼等不良生活习惯均为IDH的高危因素[20]。此外, 肥胖、糖尿病、血脂异常、高尿酸血症、高原红细胞增多症等多种慢性疾病是患高血压病公认的危险因素, 可增加早期死亡风险, 对国民经济和公共医疗造成沉重负担[21-22]。

在IDH患病预测模型中, 年龄、心率、BMI、WC、HGB和LDL-C对IDH患病有较好的预测价值。心率上升意味着交感神经的过度激活, 对引发高血压、心力衰竭等有促进作用[23]。既往研究已证实BMI和WC在IDH患病率的预测关联, IDH的发生风险随BMI的增加而增加[24]。脂肪过度堆积会释放过多的脂肪因子, 代谢异常, 造成血管壁损伤、水钠潴留等反应, 从而发生高血压[25]。在正常体质量状态下, 中心性肥胖也能有效预测高血压[26-27]。目前的IDH患病预测模型多强调BMI[20,28], 但BMI不能体现脂肪分布特征。而增加WC指标, 可进一步有效预测IDH患病风险。高原红细胞增多症患者的RBC、HGB、HCT显著增高, 临床上多表现为舒张压升高[29]。因此将IDH考虑为高原红细胞增多症的并发症之一。但对其发生机制, 需进一步研究探索。而LDL-C异常升高也会导致内皮损伤, 使生理性血管舒缩活动丧失, 从而导致全身血压升高。将高原病相关指标HGB和LDL-C纳入, 不仅验证了BMI、WC、HGB及LDL-C四种指标与IDH患病风险之间的关联, 还进一步证实这四种指标可以有效预测IDH的患病风险。

综上所述, 西藏地区世居藏族人群IDH患病率较高, 近1/3的高血压患者患有IDH, 应重点关注中青年人群。考虑到所调查藏族人群文化水平不高, 多数居住在农牧区, 需采取适用于西藏地区农牧民的知识宣教, 对超重肥胖、中心性肥胖、高原红细胞增多症和血脂异常等人群进行分层风险管理, 更有利于识别高风险人群。同时, 西藏医疗卫生水平有限, 疾病的防控相对困难, 需落实到基层公卫, 增加基层医疗设施及资源, 及时控制IDH进一步发生发展。

*　　*　　*

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Author Contribution　ZHOU Yaxi is responsible for conceptualization, formal analysis, investigation, methodology, writing--original draft, and writing--review and editing. XIONG Hai is responsible for conceptualization, funding acquisition, methodology, supervision, and writing--review and editing. ZHONG Huaichang is responsible for formal analysis, investigation, methodology, and writing--review and editing. WAN Yang is responsible for methodology, supervision, and writing--review and editing. ZHANG Yufei is responsible for conceptualization and methodology. All authors consented to the submission of the article to the Journal. All authors approved the final version to be published and agreed to take responsibility for all aspects of the work.

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