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Factors influencing changes in the quality of life of the Hainan migratory population with hypertension: a survey of the Chengmai mangrove bay community

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Abstract

Background Hainan is a tropical island in China with a large migratory population. Study have reported that the blood pressure of Hainan elderly hypertensive migratory population decreased significantly, which may be related to the improvement of environment and quality of life (QoL). Understanding the changes of QoL of these people before and after coming to Hainan and its influencing factors can provide a basis for the prevention and control of hypertension.

Methods A cross-sectional study of elderly hypertensive migratory population were conducted in Chengmai Mangrove Bay community of Hainan from December 2021 to January 2022. Convenience sampling was used to recruit elderly hypertensive migratory individuals reside stay of longer than one month. After obtaining informed consent, we investigated the demographic characteristics of the participants and evaluated their QoL with the SF-36 twice; one round of the SF-36 was about their hometown, and the other round was about living in Hainan for 1 month. The Cronbach's α coefficient and KMO value of SF-36 were both greater than 0.8, indicating good reliability and validity. The difference in blood pressure between that observed in Hainan and that observed in their hometowns was used to determine whether the Body Pain change in the subjects decreased or did not decrease after migrating to Hainan. Univariate analysis was performed via paired t tests and Kendall's tau-b tests, and multiple linear regression analysis and logistic regression analysis were used to analyse the factors influencing the QoL of the participants.

Results A total of 305 hypertensive migratory individuals participated in this study. Among them, there were 148 males (48.52%) and 157 females (51.48%), with a mean age of 68.61 ± 9.39 years. The postmigration scores for the 8 subscales of QoL, the global score, the Physical Component Score, and the Mental Component Score were all higher than the scores for their hometowns ($P < 0.05$). Factors such as gender ($r = 0.139$, $P < 0.05$), age ($r = 0.209$, $P < 0.05$), and level of education (r=-0.133, $P < 0.05$) were associated with changes in the QoL of the participants. The conditions of

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green and water spaces in their hometown, sleep habits in their hometown and ventilation habits in their hometown were the major factors influencing the subjects' QoL in their hometown ($P<0.05$). The factors that influenced the improvement in the subjects' QoL in Hainan included hypertension classification (OR = 2.336, 95% CI: 1.125 ~ 4.853, $P=0.023$) and BMI (OR = 6.402, 95% CI: 1.009 ~ 40.624, $P=0.049$).

Conclusion The QoL of hypertensive migratory population in Hainan improved with respect to individual health, physiological function, psychological function and social function. The lower the hypertension classification and BMI are, the greater the improvement in the QoL of hypertensive migratory population.

Keywords Hypertensive migratory population, SF-36, QoL, Hainan

Introduction

The proportion of the elderly population in China is increasing, and this population has a large age span and obvious heterogeneity in health status [1]. At present, the prevalence rate of hypertension in China between 40 and 59 years old is 52.5%, and 71.6% for over 60 years old, which brings many challenges to clinical diagnosis and treatment and chronic disease management [2]. Research indicates that lifestyle changes, such as adopting a balanced diet and increasing physical activity, can effectively reduce the incidence of hypertension [3–4]. Therefore, finding an effective lifestyle for the elderly with hypertension to control blood pressure is crucial for preventing cardiovascular and cerebrovascular diseases.

The occurrence and development of hypertension are influenced by the interaction between environmental and genetic factors [5]. Environmental factors such as temperature, light and air pollutants can directly or indirectly influence of hypertension [6]. Study have reported that the death events caused by blood pressure fluctuation and hypertension-related factors have obvious seasonal characteristics and are closely related to temperature, which may be related to the hemodynamic changes related to low temperature and the increased risk of thrombosis [7]. Several studies have showed that $PM_{2.5}$, PM_{10}, SO_2, NO_X are closely related to the blood pressure, which can cause oxidative stress and inflammation, and leading to increase blood pressure and positively correlated with the risk of admission rate related to hypertension [8–9]. Meantime, extreme weather and serious air pollution could cause people to be unable to carry out outdoor activities, or affected people's emotional and other mental health then influence people's quality of life (QoL) [10–11].

QoL, according to the WHO definition, is the self-perception of individuals' current position in life with respect to what goals, expectations, standards, priorities, culture and value system they might have in their living environment [12]. QoL of the elderly could be divided into nine areas, including health perception, autonomy, role and activity, social relationships, attitude and adaptation, emotional comfort, spirituality, home and neighbourhood, financial security [13]. Studies have shown that QoL of hypertension patients are significantly lower than that of healthy individuals [14–16].

Hainan Province has an excellent climatic environment, attracting many migratory old people from northern China during the winter–spring season every year [17]. These individuals, called migratory bird population, generally migrate to Hainan in October or November and then return home in the spring. The number of migratory individuals in Hainan reached 1.3 million in 2018, with predominantly individuals aged 60 and above [18]. About 27.6% of Hainan elderly migratory individuals had at least one major disease, including hypertension (19.9%), diabetes (8.8%) and coronary heart diseases (6.8%), problems with the continuity of health care services during migration may affect their physical health and health care needs [19]. Several studies have explore the relationship between the hypertensive migratory population's length of migratory stay and their blood pressure control and blood pressure levels [20–22]. Chen Sikun et al. have found that a Ushaped curve relationship between length of stay in Wuzhishan of Hainan and systolic blood pressure (overall: $P=0.001$; nonlinearity: $P=0.033$), and a linear negative correlation with diastolic blood pressure (β=-1.19, $P=0.003$). Na Li et al. have reported that the longer the migratory population lived in Chengmai of Hainan, the lower the TNF-α and MDA level. These results indicate that the potential antihypertensive effects of migration behavior.

Previous studies focused on hypertension in general or in a specific area, and more on physiological indicators (such as blood pressure control) or a single dimension of QoL assessment. Less attention is paid to the special group of migratory population. Factors such as the lifestyle, migration patterns and environmental changes of migratory population may have a unique impact on their QoL. In this study, we aimed to explore the factors that influence the changes in the QoL of Hainan elderly migratory individuals with hypertension to provide a theoretical basis to better adapt their migratory life and offer references for improving the QoL of hypertensive migratory population.

Materials and methods

Study design

Study population

A cross-sectional study of elderly hypertensive migratory population were conducted in Chengmai Mangrove Bay community of Hainan from December 2021 to January 2022. The study protocol was approved by the Ethics Committee of Hainan Medical University (No. HYLL-2020-030) prior to the beginning of the study. All participants provided written informed consent before inclusion. The convenience sampling method was used to recruit participants who met the following criteria: (a) Hypertensive migratory individual (systolic blood pressure≥130 mm Hg or diastolic blood pressure≥80 mm Hg; or both), aged above 50 years old; (b) arriving in Chengmai within the past week and planning to reside in Chengmai for at least one month; (c) were conscious and compliant with good adherence; (d) lacked acute illnesses or acute exacerbations of chronic diseases and severe mental or psychological disorders; (e) were able to communicate verbally or in writing and could attend follow-up visits at the scheduled times.

Blood pressure and BMI testing

Thirty minutes before the measurement began, the participants were in a resting state, avoiding strenuous exercise and emotional agitation. Avoid consuming caffeinated beverages and foods high in salt and fat and take the measurement at a suitable room temperature (18～25℃) and humidity (50%~80%). The participants should rest quietly for at least 5 min before the measurement, keep a comfortable sitting position, and place their arms flat on the table with their arms facing up. The arm height should be at the same level as the heart, and ensure that the blood pressure monitor, arm and heart are at the same level. The allied health care staff of the community hospital should use blood pressure meter (Omron HEM-7121) to measure the blood pressure of the participants. Blood pressure was measured 3 times and the average was taken as the final result. BMI was calculated as weight in kilograms divided by the square of height in metres.

Sample size estimation

Kendall suggested that as a rough guide, the sample size should be 5～10 times the number of variables [23]. The SF-36 in this study has 36 items and therefore requires a sample of at least 180 participants. After the addition of a 20% nonresponse rate, the necessary sample size was at least 216. A total of 305 potentially eligible participants were eventually identified. The power analysis of paired T-test was used to calculate the sample size, and the software G*power3.1 was used for the calculation. The required parameters and their values were as follows: the significance level (α) was 0.05, the test efficacy (1-β) was 0.95, and the Effect size d was 0.5, to obtain the minimum sample size of 210 participants. Therefore, the sample size included in this study is sufficient.

Variables

The sociodemographic characteristics investigated via the questionnaire included gender, age, level of education, hypertension classification, occupational type, lifestyle behaviours such as smoking status, drinking status, dietary habits and sleep habits, and living environment in Hainan and in their hometowns (Additional file 1).

Index definition: (a) BMI was categorized as normal (18.5～24.0 kg/m^2), overweight (24.0～28.0 kg/m^2), or obesity (≥28.0 kg/m^2); (b) hypertension classification was categorized as stage I hypertension (systolic blood pressure=130～139 mm Hg or diastolic blood pressure=80～89 mm Hg) or stage II hypertension (systolic blood pressure≥140 mm Hg or diastolic blood pressure≥90 mm Hg) and above; (c) smoking status was defined as having smoked at least 3 cigarettes/week for at least 6 months or more; (d) drinking status was defined as drinking an average of 100 ml of liquor (≥50% alcohol) per day for at least 1 year.

Quality of life evaluation and tools

QoL evaluation tools

The tools commonly used for assessing QoL include the 36-Item Short-form Health Survey (SF-36), the Euro-QoL Five-dimensional questionnaire (EQ-5D) and the Quality of Life Questionnaire-30 (QLQ-C30) [24]. The reliability, validity and sensitivity of the SF-36 were demonstrated to be fully applicable to the assessment of QoL in Chinese hypertensive patients [25]. The EQ-5D has advantages such as conciseness and wide applicability, but its scores represent only the health status of the population before utility value conversion. Moreover, it has shortcomings such as a ceiling effect and inconsistent distributions in some dimensions. The European Organization for the Research and Treatment of Cancer considered the QLQ-C30 to be one of the most widely used instruments for assessing health-related QoL in patients with cancer [26]. Thus, SF-36 is more suitable for evaluating QoL of elderly patients with hypertension. We surveyed the participants about their QoL as measured by the SF-36 in their hometowns from October to December 2021. One month later, the volunteers were surveyed again on the SF-36 to assess their QoL in Hainan.

SF-36 evaluation

The SF-36 component summary scores (eight subscales, Physical Component Score, and Mental Component Score) were calculated via the 36 items that are embedded in the SF-36. On the basis of the response to individual

Table 1 Basic characteristics of participants

Variates		*n* (%)	Variates		*n* (%)
Gender	Male	148 (48.52)	Education level	Elementary school and below	28 (9.18)
	Female	157 (51.48)		Junior high school	69 (22.62)
Age (years)	≤ 65	140 (45.90)		Secondary vocational school or high school	99 (32.46)
	> 65	165 (54.10)		Junior college or above	109 (35.74)
Hypertension classification	Stage 1 Hypertension	295(96.72)	Smoking	No	224 (73.44)
	Stage 2 Hypertension and above	10 (3.28)		Yes	81 (26.56)
Changes in blood pressure in Hainan	No	106 (34.75)	Drinking	No	175 (57.38)
	Yes	199 (65.25)		Yes	130 (42.62)
Family history of cardiovascular disease	No	215 (70.49)	BMI	Normal	134 (43.93)
	Yes	90 (29.51)		Overweight	127 (41.64)
				Obesity	44 (14.43)

Table 2 Comparison of characteristics of participants in Hainan and in their hometowns

Variates	Hainan (*n*, %)		Hometown (*n*, %)	
	Yes	No	Yes	No
Sleep habit	245 (80.33)	60 (19.67)	214 (70.16)	91 (29.84)
Ventilation habit	293 (96.07)	12 (3.93)	291 (95.41)	14 (4.59)
Green and water spaces	305 (100.00)	0 (0.00)	253 (82.95)	52 (17.05)

items comprising the 8 subscales and using a z score transformation, the scores of each subscale were calculated. For the SF-36, weighted subscales were employed to score the Physical Component Score and Mental Component Score. The Physical Component Score includes Physiological Function, Role Physical, Body Pain, and General Health, whereas the Mental Component Score comprises Vitality, Social Functioning, Role Emotion, and Mental Health [27]. The total scores for each domain were converted to a scale of 0 to 100. A higher score on the questionnaire is indicative of better QoL. In addition, the reliability and validity of the scale for determining the QoL of elderly people with hypertension has been confirmed. Finally, the scores were converted as shown in Formula 1. The Cronbach's α coefficient and KMO value of SF-36 were both greater than 0.8, indicating good reliability and validity.

$$Score = \frac{actual\ score - the\ lowest\ possible\ score\ of\ the\ subscale}{the\ highest\ score\ of\ the\ subscale - the\ lowest\ score\ of\ the\ subscale} \times 100$$

Statistical analysis

A database was established via EpiData 3.1 software, and all the data were double entered and verified. Statistical analysis was performed via SPSS 20.0 software. Continuous variables and categorical data are expressed as the means ± SDs and percentages, respectively. A paired t test was used to compare the differences in QoL between Hainan and hometowns. Kendall's tau-b analysis was carried out to determine the relationships between the characteristics of participants and QoL scores, and multiple linear regression analysis was used to analyse the associations of QoL scores in Hainan and hometowns with the characteristics of participants. Logistic regression analysis was used for multifactor analysis of factors affecting the improvement in the QoL scores of participants. A two-sided $P<0.05$ was considered to indicate statistical significance.

Results

Basic characteristics of participants

A total of 305 participants were recruited and completed the entire study, including 148 males (48.52%) and 157 females (51.48%). The ages of participants with an average of 68.61 ± 9.39 years. Among them, 199 participants (65.25%) experienced a decrease in blood pressure in Hainan. The number of people who had appropriate sleep and ventilation habits and lived in areas surrounded by green and water spaces was greater in Hainan than in their hometowns (Tables 1 and 2).

QoL evaluation by the SF-36

Comparison of QoL scores of participants in Hainan and in their hometowns

In Hainan, the participants' QoL scores increased significantly in every aspect (Table 3). In terms of physical health, Role Physical had the highest score (93.11 ± 18.74, $P<0.001$). In terms of mental health, Role Emotion had the highest score (96.9 ± 10.72, $P<0.001$). In Hainan, more than 89% of participants had increased QoL scores, with the highest proportion of participants with General

Table 3 Comparison of QoL scores of participants

Scale	Hometown (*N* = 305)	Hainan (*N* = 305)	Ascending group (*n*, %)	Descending group (*n*, %)
Physiological Function	83.79 ± 13.75	86.98 ± 12.44*	283 (92.79)	22 (7.21)
Role Physical	81.72 ± 32.44	93.11 ± 18.74*	296 (97.05)	9 (2.95)
Body Pain	64.30 ± 12.25	72.11 ± 8.38*	294 (96.39)	11 (3.61)
General Health	53.53 ± 11.22	65.95 ± 12.47*	301 (98.69)	4 (1.31)
Vitality	69.23 ± 7.10	77.05 ± 7.07*	291 (95.41)	14 (4.59)
Social Functioning	74.75 ± 8.37	78.33 ± 7.55*	287 (94.10)	18 (5.90)
Role Emotion	89.95 ± 21.82	96.94 ± 10.72*	300 (98.36)	5 (1.64)
Mental Health	78.03 ± 6.59	81.95 ± 6.87*	274 (89.84)	31 (10.16)
Global score	595.30 ± 78.87	652.43 ± 58.33*	290 (95.08)	15 (4.92)
Physical Component Score	70.83 ± 13.50	79.54 ± 9.83*	288 (94.43)	17 (5.57)
Mental Component Score	77.99 ± 8.38	83.57 ± 5.98*	281 (92.13)	24 (7.87)

*: Compare to hometown scores, *P*<0.001

Table 4 Relationships between QoL scores of participants in Hainan and blood pressure changes

Scale	Decreased blood pressure group (*n* = 199)	Undecreased blood pressure group (*n* = 106)	*P*
Physiological Function	86.41 ± 11.88	88.07 ± 13.41	0.845
Role Physical	91.71 ± 20.27	95.75 ± 15.23	0.051
Body Pain	72.68 ± 7.26	71.03 ± 10.10	0.064
General Health	65.86 ± 12.00	66.12 ± 13.35	0.861
Vitality	76.96 ± 7.22	77.22 ± 6.80	0.763
Social Functioning	77.95 ± 8.32	79.04 ± 5.80	0.230
Role Emotion	96.15 ± 11.69	98.43 ± 8.46	0.052
Mental Health	81.87 ± 7.16	82.11 ± 6.32	0.768
Global score	648.97 ± 61.53	658.92 ± 51.46	0.156
Physical Component Score	79.01 ± 10.18	80.53 ± 9.10	0.199
Mental Component Score	83.23 ± 6.37	84.20 ± 5.14	0.179

Health at 98.69%, followed by those with Role Emotion and Role Physical at 98.36% and 97.05%, respectively.

Effects of blood pressure changes on the QoL of participants in Hainan

In Hainan, 199 participants (65.25%) experienced a decrease in blood pressure, and there was no reduction in blood pressure in 106 participants (34.75%). We compared the QoL scores of these two groups of participants, and there was no statistically significant difference (Table 4).

Factors influencing participants' QoL

Factors influencing QoL in Hainan and in their hometowns

The QoL scores of the participants were significantly higher in Hainan than in their hometowns ($P<0.05$). Participants with age≤65 years, high educational levels, and drinking status had higher QoL scores in their hometowns ($P<0.05$). When they came to Hainan to live for a month, QoL scores of males, participants aged≤65 years, highly educated participants, smokers, and drinkers were higher than those of the other groups ($P<0.05$), and QoL scores of the participants with appropriate ventilation habits were lower than those of the other groups ($P<0.05$) (Table 5).

Factors influencing the difference in QoL scores between Hainan and hometowns

The correlations were assessed by Kendall's tau-b analysis, which revealed that gender, age, and hypertension classification ($P<0.05$) were positively correlated with Physiological Function score, BMI and drinking status ($P<0.05$) were negatively correlated with Mental Health score. In addition, age ($P<0.05$) was found to be positively correlated with Role Physical scores (Additional file 2).

Correlations of QoL with sociodemographic and lifestyle between Hainan and hometowns

Age, BMI and education level affected the QoL scores of participants in Hainan

Drinking and smoking had positive influences, whereas older age, obesity, and ventilation habits in Hainan had negative influences on Physiological Function, Role Physical, and Mental Health scores (Table 6).

Green and water spaces and sleep habits affected the QoL scores of participants in hometowns

Having green and water spaces in the hometown, sleep habits in the hometown, and drinking and smoking status had positive influences, whereas older age, having less education, and having poor ventilation habits in

Table 5 Globel scores of participants according to characteristics

Characteristics		Hometown	Hainan	*P*
Gender	Male (ref)	604.02 ± 79.00	661.23 ± 56.23	< 0.001
	Female	587.07 ± 78.11	645.05 ± 59.92[a]	< 0.001
Age (years)	≤ 65 (ref)	628.15 ± 59.73	680.00 ± 43.89	< 0.001
	> 65	567.42 ± 82.49[b]	629.91 ± 59.84[b]	< 0.001
Smoking	No (ref)	590.55 ± 80.72	647.27 ± 59.74	< 0.001
	Yes	608.43 ± 72.39	668.48 ± 52.72[c]	< 0.001
Drinking	No (ref)	586.98 ± 81.78	642.30 ± 61.32	< 0.001
	Yes	606.49 ± 73.62[d]	667.18 ± 51.67[d]	< 0.001
Education Level *	Elementary school and below	554.37 ± 78.34	605.67 ± 58.86	< 0.001
	Junior high school	574.55 ± 83.52	636.24 ± 60.76	< 0.001
	Secondary vocational school or high school	597.42 ± 75.24	658.81 ± 50.90[ef]	< 0.001
	Junior college or above	617.01 ± 72.52[ef]	670.22 ± 55.12[ef]	< 0.001
BMI *	Normal	595.36 ± 79.15	656.59 ± 63.35	< 0.001
	Overweight	601.08 ± 75.22	654.51 ± 51.19	< 0.001
	Obesity	578.40 ± 87.38	637.02 ± 62.47	< 0.001
Hypertension classification	Stage 1 Hypertension (ref)	595.95 ± 79.00	652.97 ± 58.96	< 0.001
	Stage 2 Hypertension and obove	575.99 ± 76.30	636.37 ± 32.91	0.034
Family history of cardiovascular disease	No (ref)	592.73 ± 79.27	653.34 ± 56.51	< 0.001
	Yes	601.43 ± 78.01	650.18 ± 62.74	< 0.001
Changes in blood pressure in Hainan	No (ref)	604.87 ± 68.43	658.92 ± 51.46	< 0.001
	Yes	590.20 ± 83.62	648.97 ± 61.54	< 0.001
Sleep habits	No (ref)	591.18 ± 79.72	660.30 ± 45.36	< 0.001
	Yes	597.05 ± 78.63	650.50 ± 61.02	< 0.001
Ventilation habits	No (ref)	632.38 ± 64.49	696.06 ± 65.11	0.020
	Yes	593.51 ± 79.15	650.64 ± 57.46[g]	< 0.001
Green and water space	No (ref)	591.03 ± 70.43	-	-
	Yes	596.18 ± 80.60	652.43 ± 58.33	< 0.001

[*] 1-way ANOVA F-statistic

[a, b, c, d, e, f, g] Differences based on independent samples t-test or 1-way ANOVA F-statistic, $P < 0.05$

the hometown had negative influences on Physiological Function, Body Pain, General Health and Vitality scores (Table 7).

Hypertension classification and BMI were the main factors affecting the difference in QoL scores of participants in Hainan

By comparing the scores of each dimension before and after the two surveys, an increase in QoL was defined as a difference greater than 0; otherwise, it was considered not improved. Multiple logistic regression analysis was conducted with the 8 subscale scores, global score, Physical Component Score, and Mental Component Score as the dependent variables and gender, age, smoking status, drinking status, education level, BMI, and the other 15 factors as the independent variables.

BMI and changes in blood pressure in Hainan were found to influence the improvement in Global score (BMI: OR = 6.402, 95% CI: 1.009 ~ 40.624, $P = 0.049$; changes in blood pressure: OR = 5.175, 95% CI: 1.031 ~ 25.976, $P = 0.046$). In addition, education level (OR = 6.180, 95% CI: 1.193 ~ 32.011, $P = 0.030$), changes in blood pressure in Hainan (OR = 2.755, 95% CI: 1.053 ~ 7.213, $P = 0.039$), and hypertension classification (OR = 2.336, 95% CI: 1.125 ~ 4.853, $P = 0.023$) were the factors influencing improvements in Physiological Function, Mental Health, and Mental Component Score, respectively (Table 8).

Discussion

Owing to the unique environmental and climatic conditions of Hainan, as well as the increasing awareness of health management, migratory individuals are provided favourable living conditions, and accordingly, their QoL has improved as well. In this study, our results showed that after migrating to Chengmai in Hainan for one month, the scores of various dimensions of the SF-36 questionnaire significantly improved, indicating noticeable improvements in both physical and mental health of elderly hypertensive migratory individuals. Similar findings by Duan Shengkui et al. [28], who conducted research on migratory elderly individuals in Sanya, also suggest that the better the adaptability to living in a different place is, the higher the QoL. In addition, our finding suggested that elderly hypertensive migratory individuals presented the highest scores in terms of

Table 6 Factors influencing QoL scores of participants in Hainan

Scale	Characteristics	β	95%CI	VIF	*P*
Physiological Function	≤ 65 years	-	-	-	-
	> 65 years	-11.165	(-13.651 ~ -8.680)	1.021	< 0.001
	Non-drinking	-	-	-	-
	Drinking	3.558	(1.052 ~ 6.064)	1.021	0.006
Role Physical	≤ 65 years	-	-	-	-
	> 65 years	-6.303	(-10.445 ~ -2.161)	1.028	0.003
	Non-drinking	-	-	-	-
	Drinking	5.987	(1.824 ~ 10.149 ~)	1.021	0.005
	BMI Normal	-	-	-	-
	BMI Obesity	-6.379	(-12.195 ~ -0.563)	1.007	0.032
Body Pain	≤ 65 years	-	-	-	-
	> 65 years	-4.260	(-6.094 ~ -2.425)	1.000	< 0.001
General Health	≤ 65 years	-	-	-	-
	> 65 years	-11.143	(-13.618 ~ -8.669)	1.060	< 0.001
	Elementary school and below	-	-	-	-
	Junior college or above	3.895	(1.338 ~ 6.453)	1.046	0.003
	Non-drinking	-	-	-	-
	Drinking	2.861	(0.407 ~ 5.316)	1.026	0.022
Vitality	≤ 65 years	-	-	-	-
	> 65 years	-4.619	(-6.134 ~ -3.104)	1.099	< 0.001
	Elementary school and below	-	-	-	-
	Secondary vocational school or high school	2.170	(0.324 ~ 4.016)	1.440	0.021
	Junior college or above	3.582	(1.748 ~ 5.416)	1.488	< 0.001
Social Functioning	≤ 65 years	-	-	-	-
	> 65 years	-2.172	(-3.932 ~ -0.371)	1.145	0.017
	Elementary school and below	-	-	-	-
	Secondary vocational school or high school	4.214	(0.961 ~ 7.467)	3.360	0.011
	Junior college or above	4.695	(1.408 ~ 7.981)	3.592	0.005
Role Emotion	≤ 65 years	-	-	-	-
	> 65 years	-3.053	(-5.454 ~ -0.652)	1.000	0.013
Mental Health	≤ 65 years	-	-	-	-
	> 65 years	-2.690	(-4.194 ~ -1.186)	1.030	< 0.001
	Non-smoking	-	-	-	-
	Smoking	2.403	(0.715 ~ 4.091)	1.019	0.005
	Non-Ventilation habit in Hainan	-	-	-	-
	Ventilation habit in Hainan	-4.668	(-8.529 ~ -0.807)	1.032	0.018
Global score	≤ 65 years	-	-	-	-
	> 65 years	-41.819	(-53.994 ~ -29.644)	1.112	< 0.001
	Non-drinking	-	-	-	-
	Drinking	14.283	(2.443 ~ 26.123)	1.034	0.011
	Elementary school and below	-	-	-	-
	Junior college or above	27.329	(12.594 ~ 42.064)	1.504	< 0.001
	Secondary vocational school or high school	19.204	(4.388 ~ 34.019)	1.452	0.018
Physical Component Score	≤ 65 years	-	-	-	-
	> 65 years	-7.481	(-9.505 ~ -5.456)	1.112	< 0.001
	Non-drinking	-	-	-	-
	Drinking	3.098	(1.129 ~ 5.068)	1.034	0.002
	Elementary school and below	-	-	-	-
	Junior college or above	3.941	(1.490 ~ 6.392)	1.504	0.002
	Secondary vocational school or high school	3.129	(0.665 ~ 5.593)	1.452	0.013
Mental Component Score	≤ 65 years	-	-	-	-
	> 65 years	-2.860	(-4.182 ~ -1.537)	1.111	< 0.001
	Elementary school and below	-	-	-	-

Table 6 (continued)

Scale	Characteristics	β	95%CI	VIF	*P*
	Junior college or above	5.091	(2.687 ~ 7.494)	3.390	0.000
	Secondary vocational school or high school	3.854	(1.451 ~ 6.257)	3.235	0.002
	Junior high school	2.926	(0.464 ~ 5.388)	2.711	0.020

"-" is the reference group

"VIF" is the Variance Inflation Factor

physical function with respect to role physical and in role emotion with respect to mental health. Physical health and mental health are closely related, and maintaining good mental health is crucial for preventing and treating hypertension. In Hainan, the outdoor activities of migratory individuals have significantly increased, which helps improve their mood and psychological state, promotes improvements in their physical health, and makes them feel energetic and happy, thereby contributing to maintaining good emotional function.

As age increases, various systems of the body, including the cardiovascular system, may undergo degeneration [29]. Hypertension can further burden the heart and blood vessels. With the continuous advancement of medical technology and increasing attention to health, the importance of QoL in disease management is becoming increasingly significant. Zheng EW et al. utilized the EQ-5D-3 L to measure QoL of elderly hypertensive patients in Heilongjiang Province, China. The findings revealed that elderly hypertensive patients reported significantly more problems in each of the EQ-5D domains and had a lower health utility index than did the local general population. This could be attributed to the fact that hypertensive patients are prone to various diseases, such as myocardial infarction, angina, stroke, and renal failure, which are major risk factors for reducing QoL [30]. Chen Qi et al. used the SF-12 to measure the QoL of middle-aged and elderly hypertensive patients in Xuan'en County, Hubei Province. The findings revealed that middle-aged and elderly hypertensive patients in Xuan'en County generally presented Physical Component Score and Mental Component Score below normal limits, indicating a low QoL [31]. Additionally, they suggested that sleep quality and physical exercise play important roles in determining the QoL of hypertensive patients. This may be attributed to poor sleep quality leading to decreased attention and memory, while inadequate sleep duration or long-term poor sleep quality can affect the body's immune system, worsening the health status of hypertensive patients and thus reducing their QoL.

In this study, we found that BMI was a risk factor for higher global scores, with QoL scores decreasing as BMI increases. Aslam N et al. [32] conducted a QoL survey using the EQ-5D-5 L among hypertensive individuals in the Karachi. These results showed that individuals with a normal BMI had greater QoL than did individuals with overweight or obesity. This is attributed to the increased burden on the heart and blood vessels associated with being overweight or obese, which may lead to serious health issues such as heart disease and stroke. Being overweight or obese may cause psychological issues such as decreased self-esteem, anxiety, and depression, further impacting QoL. Moreover, being overweight or obese may limit social activities such as participating in outdoor activities and exercise, which can affect social interactions and life satisfaction. Studies have indicated that increasing the frequency of physical activity can improve the QoL of hypertensive patients [33].

Blood pressure classification was another significant risk factor for a higher mental component score among the participants in this study, with higher blood pressure classifications associated with a lower mental component score. Yan RH et al. utilized the EQ-5D to measure the QoL of 13,542 hypertensive patients recruited from 180 clinical centres in China after interventions such as blood pressure control [34]. The results revealed a decrease in blood pressure levels and an improvement in QoL among the study subjects after the intervention. This is consistent with our findings, as the blood pressure classification increases, the severity of hypertension gradually worsens, leading to a greater impact on QoL. Additionally, hypertensive patients may experience anxiety and depression due to the presence of the disease, which could also negatively affect their QoL.

During our investigation, it was winter in Hainan, with temperatures generally ranging from 13 to 22 °C, which are much warmer than those in colder regions in the north. Our survey revealed that the global score of hypertensive migratory individuals in Chengmai was associated with their good ventilation habits, with 96.07% of the study participants having a habit of opening windows for ventilation. Yu QT et al. have reported that natural ventilation had the greatest impact on blood pressure. Regular ventilation could promote blood circulation, and fresh air can stimulate circulation, helping to lower blood pressure [35]. Hainan has a tropical monsoon climate with warm and humid conditions throughout the year, no frost or snow, and relatively long average daily sunshine hours. Chengmai, known as one of the world's longevity villages, boasts 2200 acres of natural mangrove wetland resources. This community is adorned with various types of greenery and equipped walking parks, orchards, and

Table 7 Factors influencing QoL scores of participants in hometowns

Scale	Characteristics	β	95%CI	VIF	*P*
Physiological Function	≤ 65 years	-	-	-	-
	> 65 years	-12.761	(-15.477 ~ -10.046)	1.031	< 0.001
	Elementary school and below	-	-	-	-
	Junior high school	-4.363	(-7.601 ~ -1.124)	1.033	0.008
	Non-Green and water space in Hometown	-	-	-	-
	Green and water spacer in Hometown	4.160	(0.609 ~ 7.710)	1.003	0.022
Role Physical	≤ 65 years	-	-	-	-
	> 65 years	-12.293	(-19.899 ~ -4.686)	1.148	0.002
	Non-Family history of cardiovascular disease	-	-	-	-
	Family history of cardiovascular disease	8.841	(0.897 ~ 16.785)	1.048	0.029
Body Pain	≤ 65 years	-	-	-	-
	> 65 years	-5.258	(-7.847 ~ -2.505)	1.004	< 0.001
	BMI Normal	-	-	-	-
	BMI obesity	3.209	(0.522 ~ 5.896)	1.004	0.019
	Non-Sleep habit in hometown	-	-	-	-
	Sleep habit in hometown	3.112	(0.216 ~ 6.008)	1.005	0.035
General Health	≤ 65 years	-	-	-	-
	> 65 years	-8.880	(-11.182 ~ -6.578)	1.060	< 0.001
	Elementary school and below	-	-	-	-
	Junior college or above	3.439	(1.060 ~ 5.818)	1.046	0.005
	Non-drinking	-	-	-	-
	Drinking	2.575	(0.292 ~ 4.858)	1.026	0.027
Vitality	≤ 65 years	-	-	-	-
	> 65 years	-3.778	(-5.311 ~ -2.245)	1.1185	< 0.001
	Non-smoking	-	-	-	-
	Smoking	2.147	(0.481 ~ 3.813)	1.036	0.012
	Elementary school and below	-	-	-	-
	Junior high school	-2.147	(-3.951 ~ -0.343)	1.090	0.020
	Non-Ventilation habit in hometown	-	-	-	-
	Ventilation habit in hometown	-3.607	(-7.131 ~ -0.084)	1.040	0.045
Social Functioning	≤ 65 years	-	-	-	-
	> 65 years	-2.985	(-4.849 ~ -1.121)	1.000	0.002
Role Emotion	≤ 65 years	-	-	-	-
	> 65 years	-5.949	(-10.842 ~ -1.056)	1.000	0.017
Mental Health	≤ 65 years	-	-	-	-
	> 65 years	-1.951	(-3.443 ~ -0.460)	1.054	0.011
Global score	≤ 65 years	-	-	-	-
	> 65 years	-55.814	(-72.523 ~ -39.104)	1.042	< 0.001
	Elementary school and below	-	-	-	-
	Junior college or above	22.153	(4.769 ~ 39.537)	1.042	0.013
Physical Component Score	≤ 65 years	-	-	-	-
	> 65 years	-10.192	(-13.001 ~ -7.384)	1.042	< 0.001
	Elementary school and below	-	-	-	-
	Junior college or above	4.022	(1.100 ~ 6.945)	1.042	0.007
	BMI Normal	-	-	-	
	BMI overweight	2.890	(0.107 ~ 5.674)	1.000	0.042
Mental Component Score	≤ 65 years	-	-	-	-
	> 65 years	-4.080	(-5.920 ~ -2.241)	1.000	< 0.001

"-" is the reference group

"VIF" is the Variance Inflation Factor

Table 8 Factors influencing the improvement in QoL of participants in Hainan

Scale	Variates	β	SE	Wald χ^2	*P*	OR (95%CI)
Physiological Function	Education level	1.821	0.839	4.710	0.030	6.180 (1.193 ~ 32.011)
Mental Health	Changes in blood pressure in Hainan	1.014	0.491	4.262	0.039	2.755 (1.053 ~ 7.213)
Global score	BMI	1.857	0.943	3.878	0.049	6.402 (1.009 ~ 40.624)
	Changes in blood pressure in Hainan	1.644	0.823	3.988	0.046	5.175 (1.031 ~ 25.976)
Mental Component Score	Hypertension classification	0.849	0.373	5.176	0.023	2.336 (1.125 ~ 4.853)

golf courses, resulting in a high level of greenery. These favourable climatic conditions have performed a positive effect on the blood pressure levels and QoL of hypertensive migratory individuals, and also make people more inclined to maintain indoor air circulation and freshness to improve and enhance the quality of their living environment, thereby reducing the occurrence of cardiovascular diseases and improving QoL.

Our survey results revealed that leisure activities such as Tai Chi, swimming, and walking increased among elderly hypertensive migratory individuals, compared with those in their hometowns, owing to the well-equipped infrastructure in the community. Research suggests that increasing the frequency of leisure activities can lower blood pressure levels among hypertensive patients [36]. The mechanism through which physical activity reduces blood pressure may be related to cardiac remodelling [37] and reduced peripheral vascular resistance, possibly due to neurohormonal and structural responses involving decreased sympathetic nervous system activity and increased arterial lumen diameter [38]. In addition, we found that some participants were influenced by the Hainan diet after coming to Hainan, and their diet tended to be between the taste of Hainan and their hometown. The diet in Hainan is light which could reduce the intake of sodium salt, and reduce blood lipids and other effects, can improve blood pressure control. Maintaining a light diet for a long time can also reduce the risk of multiple chronic diseases [39]. Therefore, patients with hypertension should adhere to a light diet, combined with moderate exercise, regular work and rest, smoking cessation and alcohol restriction to fully control the disease.

As life expectancy gradually increases and ageing populations become more prevalent, coupled with the trend of younger individuals being affected by hypertension, evaluating the QoL among middle-aged and elderly hypertensive patients and identifying key factors influencing their QoL are vital for hypertension management and guidance. However, our study still has some limitations as follows: (1) No intervention measures were taken during the implementation of this study, which belongs to a cross-sectional survey, so the results obtained only represent the status of each indicator of the research object in a certain period of time. In the multiple linear regression analysis, only the correlation between various variables can be obtained, and no causal relationship can be drawn, so it is difficult to draw a credible causal conclusion. (2) This study was limited to Chengmai Mangrove Bay community, Hainan, which may have selection bias and cannot fully reflect the overall situation of hypertensive migratory population in China. Therefore, more relevant investigations and studies in other regions are needed to make the conclusions more convincing. (3) This study were used convenience sampling in a community setting may limit the generalizability of results. (4) Sociodemographic and lifestyle data were collected via self-reported questionnaires, which are subject to recall bias, especially for behaviors or characteristics from participants' hometowns (e.g., prior sleep habits, environmental conditions).

In the future, more scientific sampling methods such as random sampling and stratified sampling can be adopted to ensure the representativeness and universality of samples. Secondly, the evaluation dimension of quality of life can be further refined. In addition to paying attention to physical health, mental health, social function and other aspects, the economic status, family support, medical resource utilization and other aspects of migratory birds with hypertension can also be added to reflect their quality of life more comprehensively. In addition to subjective questionnaires, objective physiological indicators (such as blood pressure, heart rate, lipid levels, etc.) and imaging examinations can be introduced to more accurately assess the health status and quality of life of hypertensive migratory population.

Conclusion

In conclusion, the hypertensive migratory population in Hainan represents a unique group of individuals who "come for winter and leave in spring". This study revealed that the QoL of these elderly hypertensive migratory population improved in various aspects when living in Hainan, such as individual health, physical function, psychological function and social function. The lower the hypertension classification and BMI are, the higher scores in the QoL. These improvement may be attributed to factors such as green space and water, recreational activities, diet and sleep habits. This study provides some useful preventive measures for hypertensive patients and reference for clinicians to implement prevention and treatment plan.

Abbreviations

QoL	Quality of Life
SF-36	36-Item Short-form Health Survey
EQ-5D	Euro-QoL Five-dimensional questionnaire
QLQ-C30	Quality of Life Questionnaire-30

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

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Author contributions
Qiaochun Chen: Writing – review & editing. Jing Zhou: collected and analysis of the data. Na Li: Investigation. Luming Liu: Investigation. Yixuan Li: Investigation. Wenfang Long: Review. Ziyue Luo: Investigation. Yunru Liu: review & editing. Sha Xiao: Supervision, writing – review & editing, Funding acquisition.All authors reviewed the manuscript.

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Data availability
The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The study was ethically conducted in accordance with the Declaration of Helsinki. The study was approved by the ethics committee of Hainan Medical University (No. HYLL-2020-030). All participants provided informed consent.

Consent for publication
Not Applicable.

Competing interests
The authors declare no competing interests.

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