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Study on the Impact of Unhealthy Lifestyles on Health-Related Quality of Life in Elderly Hypertensive Patients in Rural Areas of China

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Abstract

Objective

To examine the impact of unhealthy lifestyles on health-related quality of life (HRQoL) among elderly hypertensive patients in rural areas and to develop evidence-based intervention strategies aimed at improving their health outcomes and overall well-being.

Methods

Data from the “NCLM-Cohort_2023–2024 Database” were used, including 1105 elderly hypertensive patients residing in rural areas (n = 1105). General demographic information and data related to unhealthy lifestyles were collected. The EuroQol Five-Dimension Five-Level Scale (EQ-5D-5L) was used to assess HRQoL. Univariate and multiple linear regression analyses were conducted to explore the effects of unhealthy lifestyles on HRQoL.

Results

The median EQ-5D-5L utility value among elderly rural hypertensive patients was 0.952 (0.894, 1.000). The median EQ-Visual Analog Scale (VAS) score for HRQoL was 80.00 (70.00, 84.00). Multiple linear regression analysis indicated that the EQ-5D-5L utility value and EQ-VAS score were influenced by hypertension grade, sleep duration, difficulty falling asleep, and the number of days of moderate physical activity per week ($P < 0.05$). The frequency of animal oil consumption and daily sitting duration were significant factors influencing the EQ-5D-5L utility value ($P < 0.05$), while ethnicity, nocturnal or early morning awakenings, and the frequency of ultra-processed and fried food consumption were significant factors affecting the EQ-VAS score ($P < 0.05$). Spearman’s rank correlation analysis showed that age and daily sitting duration were negatively correlated with the EQ-5D-5L utility value ($P < 0.05$). The number of days of moderate physical activity per week and monthly salt consumption (500 g/pack) were positively correlated with the EQ-5D-5L utility value ($P < 0.05$). Daily sitting duration was negatively correlated with the EQ-VAS score ($P < 0.05$), while weekly physical activity was positively correlated with the EQ-VAS score ($P < 0.05$). Age and monthly salt consumption were not significantly correlated with the EQ-VAS score ($P > 0.05$).

Conclusions

Effective management of hypertension grade, adequate sleep duration, improvement in sleep difficulties and nocturnal awakenings, and increased moderate physical activity per week can enhance HRQoL among elderly rural hypertensive patients. In contrast, frequent consumption of animal oil, ultra-

processed foods, and fried foods, as well as prolonged sedentary behavior, negatively affect HRQoL in this population.

1 Introduction

Data from China's Seventh National Population Census show that individuals aged 60 and above account for 18.70% of the total population, with those aged 65 and above comprising 13.50%. Compared with the Sixth National Census in 2010, the proportion of people aged 60 or above increased by 5.44 percentage points, and the proportion aged 65 or above increased by 4.63 percentage points, indicating that China is entering a deeply aging society (1). China's aging population is characterized by a large elderly population, rapid growth, and uneven distribution, making it the country with the largest elderly population in the world. Hypertension is a chronic non-communicable disease characterized by elevated arterial pressure in the systemic circulation. It is a key risk factor for cardiovascular diseases but can be reversed and prevented through appropriate interventions (2). The acceleration of urbanization and population aging in China has led to a steady rise in hypertension prevalence, increasing the overall social and healthcare burden (3), particularly in rural areas where the trend is more pronounced. Currently, there are approximately 245 million hypertensive patients in China, and the population with high-normal blood pressure continues to grow. The overall awareness, treatment, and control rates of hypertension remain low—only 43.3%, 38.7%, and 12.9%, respectively (4). The prevalence of hypertension among rural residents is higher than among urban residents, while their treatment control and health-related quality of life (HRQoL) levels are comparatively lower (5, 6). Hypertension is a major risk factor for kidney disease (7, 8), stroke (9), premature birth (10), heart failure (11), and cardiovascular disease (12, 13), affecting 70%–80% of patients with chronic kidney disease (CKD) and contributing to the progression of end-stage renal disease (14). As a lifelong condition, hypertension requires continuous management to control blood pressure and prevent disease progression (15). Lifestyle directly influences HRQoL in hypertensive patients; for instance, prolonged sitting (> 4 h per day), insufficient or excessive physical activity (PA), and poor sleep quality all negatively affect HRQoL (16). Primary prevention strategies—such as healthy diets, regular exercise, and good sleep habits—are essential for improving HRQoL and reducing the burden of hypertension and its complications.

HRQoL reflects physical, psychological, social, and emotional well-being. It not only captures the presence of disease but also the consequences arising from it (17). HRQoL measurement tools are increasingly used worldwide in healthcare research. Health status utility (HSU), a quantitative index representing quality-of-life weights, is a key indicator for HRQoL assessment (18). In this study, HSU was measured using the EQ-5D-5L scale to evaluate HRQoL and investigate the impact of unhealthy lifestyles among elderly rural hypertensive patients based on data from the "NCLM-Cohort_2023–2024 Database."

2 Methods

2.1 Research subjects and quality control

The data used in this study were obtained from the "Northern China Lifestyle Medicine Cohort (NCLM-Cohort)" project, which was led and hosted by Zhengzhou University and covered four provinces and municipalities, including Henan, Heilongjiang, Shandong, and Qinghai, from the "NCLM-Cohort_2023-2024" database. For quality control, standardized management of the entire process was achieved through a multi-center collaborative mechanism. The School of Public Health at Zhengzhou University organized inter-institutional experts to conduct multiple rounds of evaluation and pre-investigation verification of the survey tools to ensure their scientific validity. Unified training and assessment were conducted for investigators from all participating institutions to standardize on-site data collection procedures. A redundancy sampling method with a 20% larger sample size was implemented to enhance data reliability. After data collection, the integrity and logical consistency of the medical and public health big data were verified to ensure the accuracy and translational value of the long-term dynamic dataset.

A multi-stage stratified sampling method was used to select hypertensive patients aged over 65 years from Linkou County, Mudanjiang City, Heilongjiang Province. In the first stage, three streets (townships) were randomly selected in Linkou County. In the second stage, three villages (communities) were randomly selected from each chosen street (township). In the third stage, elderly patients with hypertension were randomly selected from the identified villages (communities) as survey participants. A total of 1105 rural elderly patients with hypertension who met the inclusion criteria in the “NCLM-Cohort_2023-2024” database were included in this study. The inclusion criteria were as follows: (1) rural household registration; (2) age ≥65 years; (3) diagnosis of hypertension and inclusion in the national basic public health service program; (4) voluntary participation in the study with signed informed consent; and (5) ability to complete the questionnaire survey. The exclusion criteria were as follows: (1) unconsciousness or mental disorders; (2) cognitive dysfunction; and (3) urban household registration. The application for the use of this database was completed in accordance with standardized procedures. After review and approval by the database project team, data use authorization was obtained. Based on this database, data analysis and manuscript preparation for this study were carried out.

2.2 Investigation tools

General demographic data included age, sex, ethnicity, marital status, education level, occupation, participation in urban–rural residents’ medical insurance, annual household income, living arrangement (living alone or with a spouse), and hypertension grade. Blood pressure (BP) was measured using a certified upper-arm electronic sphygmomanometer. After the subjects rested quietly for 3-5 minutes, they sat down with their right arm at the same level as the heart. The cuff was placed 2-3 cm above the elbow crease. Three consecutive blood pressure measurements were taken, with each interval being 1-2 minutes. The average value was taken as the blood pressure reading. If the difference between two readings was >10 mmHg, the measurement had to be repeated. The state of hypertension was determined based on the measured blood pressure, self-reported previous clinical diagnoses, and the

use of antihypertensive drugs. Hypertension grades were defined as follows: Grade Ⅰ, systolic blood pressure (SBP) of 140–159 mmHg (1 mmHg=0.133 kPa) and/or diastolic blood pressure (DBP) of 90–99 mmHg; Grade Ⅱ, SBP of 160–179 mmHg and/or DBP of 100–109 mmHg; Grade Ⅲ, SBP ≥180 mmHg and/or DBP ≥110 mmHg; high-normal blood pressure, SBP of 120–139 mmHg and/or DBP of 80–89 mmHg (19).

Lifestyle factors included sleep duration, difficulty falling asleep, frequent nighttime awakenings or early bedtime, nocturnal urination, dyspnea, loud coughing or snoring, smoking status, alcohol consumption, frequency of eating pickled and preserved vegetables, frequency of eating pickled or reprocessed meat, fish, and other foods, frequency of eating desserts, sugary beverages, animal oil, and ultra-processed foods, the number of salt packs consumed per month (500 g/pack), average daily sitting time, and the number of days of moderate PA per week.

HRQoL was measured using the EuroQol Five-Dimension Five-Level Scale (EQ-5D-5L), which comprises two parts: a five-dimensional descriptive system and the EuroQol Visual Analog Scale (EQ-VAS). (1) The five-dimensional descriptive system includes five domains: mobility (MO), self-care (SC), usual activities (UA), pain/discomfort (PD), and anxiety/depression (AD). Each domain has five levels: no difficulty, slight difficulty, moderate difficulty, severe difficulty, and extreme difficulty/unable to perform. The EQ-5D scale evolved from the three-level version (EQ-5D-3L) to the five-level version (EQ-5D-5L) (20). To quantitatively assess health status, a utility value set was used to transform and process the relevant indicators, yielding a single quantitative index—the “utility value”—representing overall health quality, ranging from -0.251 to 1.000. A value of 1.000 indicates the best possible health state, 0 represents death, and values below 0 correspond to health states worse than death. (2) The EQ-VAS is a vertical VAS that allows respondents to intuitively report their perceived health status. The scale ranges from 0 (“the worst imaginable health state”) to 100 (“the best imaginable health state”) (21). EQ-VAS provides a quantitative measure of overall self-rated health. Generally, the EQ-5D-5L utility value is positively correlated with the EQ-VAS score and respondents’ HRQoL, and the EQ-5D-5L has demonstrated good reliability and validity (22-[23]24). In this study, the Cronbach’s α coefficient for the EQ-5D-5L was 0.716.

2.3 Statistical methods

SPSS version 26.0was used for statistical analysis. Continuous variables that did not follow a normal distribution, as determined by normality testing, were expressed as M (P25, P75), while categorical variables were expressed as relative frequencies. The Mann–Whitney U test and Kruskal–Wallis H test were used to analyze relationships between HRQoL and measurement data among elderly rural hypertensive patients. Spearman’s rank correlation was used to assess associations between HRQoL and measurement data. Variables with $P<0.10$ in the above analyses were included in multiple linear regression models to evaluate the effects of general demographic and lifestyle factors on HRQoL among hypertensive patients. $P<0.05$ was considered statistically significant, and all tests were two-sided. Assign values to the variables, as shown in Table 1.

3 Results

3.1 Descriptive statistical analysis results

3.1.1 General demographic data

Descriptive analysis was conducted on the general demographic characteristics of 1105 elderly rural hypertensive patients. Among them, 483 were males (43.71%) and 622 were females (56.29%). The participants' ages ranged from 65 to 101 years, with a median age of 73 (69,77) years. There were 949 cases (85.88%) of Han ethnicity and 156 cases (14.12%) of ethnic minorities. A total of 199 participants (18.01%) were divorced or widowed, and 906 (81.99%) had other marital statuses. In terms of education, 1091 participants (98.73%) had an education level of junior high school or below. Eleven participants (0.10%) were unemployed or laid off. A total of 1090 participants (98.64%) were covered by urban–rural residents' medical insurance. Regarding household income, 494 cases (44.71%) had an annual income of < 8000 yuan, while 611 cases (55.29%) had an annual income of ≥ 8000 yuan. In terms of living arrangements, 242 participants (21.90%) lived alone, and 730 (66.06%) lived with a spouse. Blood pressure classification showed that 338 participants (30.59%) had Grade I hypertension, 82 (7.42%) had Grade II/III hypertension, and 685 (61.99%) had high-normal blood pressure.

3.1.2 Unhealthy lifestyle

Descriptive analysis of unhealthy lifestyle behaviors was performed to systematically identify and quantify the prevalence of adverse habits among this population in terms of sleep, rest, and diet. A total of 376 participants (34.03%) had a sleep duration of < 7 hours, 210 (19.00%) had difficulty falling asleep, 729 (65.97%) experienced easy or early awakening, and 765 (69.23%) reported nocturnal urination. Dyspnea was reported by 521 participants (47.15%), and coughing or loud snoring by 575 (52.04%). Smoking was reported by 276 participants (24.80%) and alcohol consumption by 157 (14.21%). Frequent consumption of pickled vegetables was reported by 690 participants (62.44%), preserved or processed meats, fish, and similar foods by 474 (42.90%), desserts by 196 (17.74%), sugary drinks by 205 (18.55%), animal oil by 211 (19.10%), ultra-processed foods by 218 (19.73%), and fried foods by 243 (21.99%).

3.1.3 HRQoL

Descriptive analysis was conducted to assess the HRQoL of the 1,105 elderly rural hypertensive patients using the EQ-5D-5L instrument. The median EQ-5D-5L utility value was 0.952 (0.894, 1.000), and the median EQ-VAS score was 80.00 (70.00, 84.00) points. The responses to each EQ-5D-5L dimension are presented in Table 2.

3.2 Univariate analysis of factors influencing the HRQoL of elderly rural hypertensive patients

Among the general demographic characteristics, significant differences in EQ-5D-5L utility values were observed across ethnicities, education levels, annual household incomes, and hypertension grades ($P < 0.05$). Significant differences in EQ-VAS scores were also observed across ethnicities, education levels, occupations, participation in urban–rural residents' medical insurance, annual household income, living alone, living with a spouse, and hypertension classification ($P < 0.05$).

Significant differences (P < 0.05) were also found in EQ-5D-5L utility values and EQ-VAS scores across variables including sleep duration, difficulty falling asleep, easy or early awakening, dyspnea, coughing or snoring, smoking status, frequency of consumption of pickled vegetables, preserved meats, animal oil, ultra-processed foods, daily sitting time, and the number of days of moderate PA per week. Furthermore, significant differences in EQ-5D-5L utility values were found for nocturnal urination, frequency of dessert consumption, sugary drink intake, and the number of salt packs consumed per month (500 g/pack) (P < 0.05), as shown in Table 3.

Spearman rank correlation analysis revealed that age and daily sitting duration were negatively correlated with the EQ-5D-5L utility value (P < 0.05), while the number of days of moderate PA per week and monthly salt pack consumption (500 g/pack) were positively correlated with it (P < 0.05). Daily sitting duration was negatively correlated with the EQ-VAS score (P < 0.05), whereas weekly PA was positively correlated with the EQ-VAS score (P < 0.05). Age and monthly salt pack consumption showed no significant correlation with EQ-VAS scores (P > 0.05), as shown in Table 4.

3.3 Multiple linear regression analysis of factors influencing the HRQoL of elderly rural hypertensive patients

3.3.1 EQ-5D-5L utility value

The EQ-5D-5L utility value of elderly rural hypertensive patients was used as the dependent variable (measured value), and variables with P < 0.10 in the univariate analysis were included as independent variables in a multiple linear regression analysis. The results showed that hypertension grade, sleep duration, difficulty falling asleep, frequency of animal oil consumption, daily sitting duration, and number of days of moderate PA per week significantly affected the EQ-5D-5L utility value (P < 0.05). The variance inflation factor (VIF) was less than 5, indicating no significant multicollinearity. The Durbin–Watson statistic was 1.837, suggesting no significant first-order autocorrelation in the residuals and a weak serial correlation, with minimal interference in the model, as shown in Table 5.

3.3.3 EQ-VAS score

For the EQ-VAS score (measured value) as the dependent variable, and variables with P < 0.10 from the univariate analysis as independent variables, multiple linear regression analysis identified ethnicity, hypertension classification, sleep duration, difficulty falling asleep, easy or early awakening, frequency of ultra-processed food consumption, frequency of fried food consumption, and number of days of moderate PA per week as significant influencing factors (P < 0.05). The VIF was less than 5, indicating no significant multicollinearity. The Durbin–Watson statistic was 1.736, indicating no significant first-order autocorrelation in the residuals, with weak serial correlation and minimal interference in the model, as shown in Table 6.

4 Discussion

The prevalence of hypertension continues to increase annually due to the accelerating aging of the population and changes in diet and lifestyle, with the growth rate being particularly significant in developing countries. As an important modifiable risk factor for cardiovascular diseases, reducing the

proportion of uncontrolled hypertension should remain a key focus of population health initiatives (25). At present, hypertension has become one of the chronic diseases with the highest prevalence (26). Hypertension is often caused by the long-term effects of pathogenic factors. Early detection through general surveys, screening, regular physical examinations, and self-monitoring, combined with timely standardized treatment to prevent disease progression and complications, can save medical resources and reduce the economic burden on families and society (27). Unhealthy behavioral lifestyles such as lack of exercise, unhealthy eating habits, smoking, and drinking are major risk factors for hypertension (16). As hypertension is a chronic progressive disease, its occurrence and progression can be effectively prevented by controlling these risk factors. Through screening and analysis using data from the "NCLM-Cohort_2023–2024 Database," a total of 1105 elderly rural hypertensive patients were included.

The EQ-5D-5L is a health status measurement scale developed by the European Quality of Life Research Group. In this study, the average HSU of elderly rural hypertensive patients measured using the EQ-5D-5L was 0.931, with a median utility value of 0.952 (0.894, 1.000), slightly lower than the national average EQ-5D-5L utility value of 0.96 for Chinese residents. A comparison reveals that the HSU obtained in this study is higher than those reported in other studies. The HSU of elderly hypertensive patients in Heilongjiang Province was 0.79 (28), the mean utility score of adults with hypertension in Jiangsu Province was 0.85 (29), and the HSU of hypertensive patients in urban and rural areas of Shaanxi Province was 0.891 and 0.870, respectively (30). The average utility and VAS scores of hypertensive patients in Pakistan were 0.64 (± 0.15) and 63.17 (± 11.01), respectively (31). The HSU in Singapore was 0.95 (32), and that in the UK was 0.9 (33). The EQ-5D-5L utility value of the present study population was higher than that of other studies involving Chinese hypertensive patients and was only slightly lower than that of Singaporean patients. This difference may be associated with combined influences of factors such as age and place of residence. Once hypertensive patients experience symptoms such as dizziness, nausea, and vomiting, they often exhibit emotional fluctuations such as irritability and anger, which can have a significant negative impact on their quality of life.

The hypertension grade is an influencing factor of the EQ-5D-5L utility value. The EQ-5D-5L utility value of patients with grade II/III hypertension is significantly lower than that of patients with grade I hypertension. Hypertensive patients should adopt comprehensive blood pressure management based on their own blood pressure levels and risk grades to effectively control blood pressure, improve HRQoL, and reduce the risks of complications and death (34). Those who frequently consume animal oil, ultra-processed foods, and fried foods tend to have lower HRQoL. The number of salt packs consumed per month was positively correlated with the EQ-5D-5L utility value. Individuals with higher intakes of solid oils, added sugars, red meat, fast food, high-fat dairy products, salty snacks, sugar-sweetened beverages, and total energy intake generally scored higher for unhealthy eating patterns (35). Hypertension risk is also positively associated with processed meat intake, and a strong positive association exists between daily sodium intake and blood pressure (36). For every 100 g/day increase in processed meat intake, the risk of hypertension increased by 14% (37). Women who frequently consume fried foods have a 2.4-fold higher risk of developing hypertension compared with those who rarely consume fried foods (27). In rural areas of northern China, winter lasts for 5 to 6 months, and fresh

vegetables are scarce. Residents have long relied on pickled vegetables, cured meat and other winter vegetables to get through the winter, making high salt intake inevitable. Animal oil is commonly used in traditional cooking, and the belief that eating meat is beneficial for the body is deeply rooted. The road traffic conditions in rural areas are relatively weak, making it rather inconvenient for the elderly to travel. Therefore, merely conveying the information of a "low-salt and low-fat diet" through health lectures is not very effective. The implementation of low-sodium salt popularization and alternative seasoning intervention, combined with local salt companies to set up low-sodium salt parity supply points in village clinics, while village doctors taught cooking skills to use local common conditioners to replace part of salt. To implement the animal oil replacement program, the village collective encourages farmers to replace small packages of rapeseed oil with a certain proportion of animal oil stored at home, and carries out healthy cooking demonstration classes to reduce the amount of red meat.

Daily sitting duration is negatively correlated with the EQ-5D-5L utility value, whereas the number of days of moderate PA per week is positively correlated. Quality of life showed a downward trend with increasing sitting time, becoming more pronounced when daily sitting exceeded 4 hours (16). Long-term lack of PA is a risk factor for hypertension (38). Regular exercise plays a vital role in promoting cardiovascular health and reducing disease risk across all age groups (39). PA enhances cardiac function, inhibits insulin resistance, reduces inflammation, and promotes vasodilation, thereby decreasing vascular resistance (40, 41). Weight loss achieved through PA, as well as alleviation of anxiety and depression, can further contribute to blood pressure reduction (42, 43). Appropriate PA can effectively improve the HRQoL of elderly rural hypertensive patients by alleviating abnormal lipid metabolism and improving cardiovascular and cerebrovascular function. However, when exercise intensity exceeds an individual’s physical capacity or habitual level, it may cause muscle injury (44). Healthy eating and regular PA are potential preventive measures for hypertension. Individuals who maintain a healthy diet and meet the recommended PA levels have a lower risk of developing hypertension than those with unhealthy dietary patterns or insufficient activity (45). In northern rural areas, the outdoor temperature in winter often drops below − 20℃, and icy and snowy roads are prone to causing falls and fractures. Village-level public fitness places are mostly outdoor equipment, which are basically idle in winter. The space for indoor activities is insufficient, and the elderly are used to sitting on the kang (heated brick bed) or by the stove for a long time and watching TV. Therefore, merely encouraging more walking and exercise is difficult to achieve. Develop "Kang Edge Health Exercises", collaborate with sports colleges or health centers to design a set of micro-exercises to be completed along the edge of a kang or bed, produce videos or illustrated manuals, and disseminate them through village broadcasts and family doctors. Utilize the village committee to carry out simple insulation renovations as a "anti-sedentary activity station" for winter. Organize collective viewing of fitness videos and manual basket weaving at fixed times each day to interrupt continuous sitting. Emphasize that "the total daily sitting time should not exceed 4 hours", and conduct self-monitoring through an electronic pedometer or a simple diary. Give a small reward for every 30 minutes of reduced sitting time. Regular exercise can therefore help reduce the risk of hypertension and associated cardiovascular and cerebrovascular diseases among elderly rural patients.

Sleep duration of less than 7 hours and difficulty falling asleep are risk factors affecting the health utility value and EQ-VAS score of elderly hypertensive patients in rural areas, which is consistent with the research of Zhu Xiaowei (46). Patients with insomnia are prone to further elevated blood pressure due to abnormal hypothalamic metabolism and elevated sympathetic nerve activation, which in turn can harm their physical health (47). Short sleep duration is defined as fewer than 7 hours per night (48). A longitudinal study involving a Chinese population found that short sleep duration, rather than long sleep duration, was a risk factor for hypertension (49). Each additional hour of sleep was found to decrease hypertension risk by 0.3207% (50). However, some studies report that both short and long sleep durations are associated with an increased risk of hypertension across most age groups (51). There is a correlation between sleep disorders and hypertension. When sleep is in an unhealthy state, it can affect blood pressure, thereby increasing the risk of hypertension. Sleep health and the management of nocturnal blood pressure during sleep are very important for preventing cardiovascular events. Participants with poor sleep patterns have a higher risk of hypertension (52, 53). Snoring and obstructive sleep apnea (OSA) may also increase the risk of vascular diseases, such as hypertension (54, 55). In the northern rural areas, the nights are long in winter, and there is a lack of night lighting and safety patrols. Most toilets are built outdoors independently, and there is no separate bathroom indoors. Some elderly people are afraid of "getting up at night" and deliberately avoid drinking water before bed, which leads to mild dehydration and makes it even more difficult for them to fall asleep. Improper management of the temperature of the kang, excessive cold of the kang will cause cold at night, physiological contraction of blood vessels will lead to abnormal increase of blood pressure, resulting in sleep fragmentation. Through the village doctor's household guidance, publicize the best Kang temperature, connect the village committee's "family connection" phone for the elderly living alone, and encourage their children to call and report safety at a fixed time every night to reduce anxiety. At the same time, train village doctors to conduct brief sleep hygiene consultations every quarter.

5 Strengths and limitations of the study

The strengths of this research are as follows. First, the selection of research subjects is both targeted and representative. The study focuses on elderly hypertensive patients in rural areas and investigates their HRQoL, which aligns with the current demographic trend of a large number of elderly individuals with hypertension in these communities. Moreover, the sample size is large and covers a wide range, thereby enhancing the generalizability and reliability of the research findings. Second, the research adopts a more systematic perspective. Whereas previous studies were mostly limited to discussions of single influencing factors, this study emphasizes the significant impact of unhealthy lifestyles on the HRQoL of this population and conducts a more comprehensive analysis, addressing previous research gaps. Third, the combined use of univariate analysis and multiple linear regression analysis allows for a scientific exploration of the effects of various unhealthy lifestyle factors on the HRQoL of elderly rural hypertensive patients. This provides a scientific basis for formulating lifestyle intervention strategies and personalized treatment plans for this group.

Regarding limitations, this study used cross-sectional survey data to analyze the correlation between HRQoL and related factors. Therefore, causal relationships between variables cannot be determined. Additionally, the questionnaire relied on the self-recall of respondents, which may have introduced recall bias.

6 Conclusion

Encouraging elderly rural patients with hypertension to modify unhealthy lifestyles is crucial for the management, prevention, and reduction of adverse outcomes related to hypertension. Frequent consumption of animal oil, ultra-processed foods, and fried foods, as well as prolonged daily sitting time, all negatively affect the HRQoL of elderly rural patients with hypertension. In contrast, regular and moderate exercise serves as a protective factor for HRQoL and significantly enhances it. In the implementation of lifestyle interventions, patients should be guided to maintain continuous follow-up care, ensure sufficient sleep duration, and address issues such as difficulty falling asleep, frequent nighttime awakenings, or early bedtime. They should also be encouraged to reduce the intake of animal oil, ultra-processed foods, and fried foods; engage in moderate PA; and control daily sitting time and blood pressure levels. These lifestyle interventions are complementary and synergistic. Together, they can effectively improve blood pressure control and provide dual health benefits, representing an important direction for hypertension management. To enhance the HRQoL of elderly rural hypertensive patients, it is essential to strengthen health education, raise awareness of hypertension prevention, and promote the development and long-term maintenance of healthy lifestyle habits.

Abbreviations

AD Anxiety/depression

CKD Chronic kidney disease

DBP Diastolic blood pressure

HRQoL Health-related quality of life

HSU Health status utility

OSA Obstructive sleep apnea

PA Physical activity

PD Pain/discomfort

SBP Systolic blood pressure

SC Self-care

SDEC Socio-demographic, economic and clinical

UA Usual activities

VAS Visual Analog Scale

VIF Variance inflation factor

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki (2024). The use of de-identified data from the NCLM-Cohort_2023-2024 Database was approved by the NCLM-Cohort project team and the Ethics Committee of Mudanjiang Medical University (Approval No.: [ZZUIRB 2023-318]). All participants provided written informed consent for data collection and secondary analysis, and their privacy was strictly protected.

Consent for publication

Consent for publication: Not applicable.

Availability of data and materials

The datasets for this study can be found in the "NCLM-Cohort_2023-2024 Database". The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author. Third-Party Material□No.

Competing interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Authors' contributions

SC: Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. PZ: Investigation, Visualization, Writing – review & editing. XZ: Investigation, Visualization, Writing – review & editing. XL: Data curation, Formal analysis, Writing – review & editing. WN: Data curation, Formal analysis, Writing – review & editing. YY: Investigation, Writing – review & editing. HL: Data curation, Investigation, Writing – review & editing. CL: Conceptualization, Funding acquisition, Methodology, Resources, Writing – review & editing.

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Tables

Tables 1 to 6 are available in the Supplementary Files section.

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