Postprint: Analysis of Abnormal Detection Rates in Health Examinations for the Elderly under the National Basic Public Health Service

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Date: 2022-12-01T00:00:00+00:00

Abstract

Background China' s National Essential Public Health Services provides free annual health checkups for elderly individuals aged 65 years and above. Health checkups represent the first step in the "early detection, early diagnosis, and early treatment" of common geriatric diseases. Few studies have reported on the contribution of elderly health checkups within essential public health services to the detection of abnormal health conditions and the awareness of these conditions among the elderly population. This study focuses on investigating the abnormal detection rate in elderly health checkups within the essential public health services framework, aiming to evaluate the effectiveness of elderly health checkups in the national essential public health service program from the demand-side perspective. Objective To investigate the abnormal detection rate in health checkup services provided for elderly individuals aged over 65 through essential public health services. Methods Using multi-stage stratified sampling, elderly patients aged $ $65 years from 20 primary healthcare institutions across 5 cities in 3 provinces in China's eastern, central, and western regions were selected as survey subjects. Based on essential public health management status, subjects were categorized into three groups: general elderly (without hypertension or diabetes), elderly with hypertension, and elderly with diabetes. One-on-one questionnaire surveys were administered to all survey subjects. Results (1) The abnormal detection rate in elderly health checkups was 67.4%, with rural elderly exhibiting higher rates than urban elderly (70.6% > 64.1%, P < 0.001); (2) Blood pressure abnormalities: The highest abnormal detection rate in elderly health checkups was for blood pressure abnormalities, with 38.9% of survey subjects self-reporting abnormal blood pressure in their most recent annual checkup results, with rural areas exceeding urban areas (41.2% > 36.6%, P = 0.010); 49.1% of elderly individuals previously diagnosed with hypertension

exhibited abnormal blood pressure values in their annual checkup, 36.1% of elderly individuals with diabetes had abnormal blood pressure values, and 18.3% of general elderly individuals were found to have abnormal blood pressure values in their most recent checkup. (3) Blood glucose abnormalities: 24.8% of survey subjects self-reported detecting abnormal blood glucose in their most recent checkup; among elderly individuals previously diagnosed with diabetes who underwent blood glucose measurement during checkups, the proportion with abnormal blood glucose was 60.5%, the abnormal blood glucose rate was 9.7% for elderly individuals with hypertension, and the screening rate for abnormal blood glucose was 8.4% for general elderly individuals. (4) The overall detection rate for anemia was 2.0%, with rural elderly exceeding urban elderly (2.6% > 1.4%, P = 0.021); the overall detection rate for fatty liver disease was 14.7%, with urban elderly exceeding rural elderly (17.2% > 12.3%, P < 0.001). (5) Compared with general elderly individuals, the abnormal blood pressure detection rate was 2.66 times higher in elderly individuals with hyperglycemia; the abnormal blood lipid detection rate was 1.64 times higher in elderly individuals with hypertension and 1.41 times higher in elderly individuals with hyperglycemia; the overweight/obesity detection rate was 2.81 times higher in elderly individuals with hypertension and 2.57 times higher in elderly individuals with hyperglycemia; the fatty liver disease detection rate was 2.10 times higher in elderly individuals with hypertension and 1.52 times higher in elderly individuals with hyperglycemia; whereas the anemia detection rate was 0.26 times that of general elderly individuals in those with hypertension and 0.50 times that of general elderly individuals in those with hyperglycemia. Compared with urban areas, abnormal blood pressure, abnormal blood glucose, and anemia in rural elderly were 1.29 times, 1.36 times, and 1.76 times higher, respectively, while the fatty liver disease detection rate in rural elderly was 0.30 times that of urban elderly. Conclusion The detection rate for blood pressure abnormalities in health checkups was relatively high; blood pressure and blood glucose control among elderly individuals with hypertension and diabetes showed some improvement; health prevention and treatment among rural elderly was inferior to that among urban elderly.

Full Text

Analysis of Abnormal Detection Rates in Health Examinations for Older Adults Under the National Basic Public Health Service

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Abstract

Background: China' s national basic public health service provides free annual health examinations for adults aged 65 and older, representing the first step toward "early detection, early diagnosis, and early treatment" of common geriatric diseases. However, few studies have examined the contribution of these services to identifying health abnormalities or older adults' awareness of such findings. This study investigates abnormal detection rates in health examinations within the basic public health service framework to evaluate program effectiveness from the demand-side perspective.

Objective: To understand abnormal detection rates in health examination services provided to adults over 65 through the basic public health service.

Methods: We employed multi-stage stratified sampling to survey adults aged $ $65 years from 20 primary healthcare institutions across 3 provinces and 5 cities in China' s eastern, central, and western regions. Based on basic public health management records, participants were categorized as general older adults (without hypertension or diabetes), hypertensive older adults, or diabetic older adults. All subjects completed one-on-one questionnaire surveys.

Results: (1) The overall abnormal detection rate was 67.4%, significantly higher in rural areas than urban areas (70.6% vs. 64.1%, P<0.001). (2) Blood pressure abnormalities represented the most common finding, with 38.9% of respondents self-reporting abnormal blood pressure in their most recent annual examination (rural: 41.2% vs. urban: 36.6%, P=0.010). Among previously diagnosed hypertensive patients, 49.1% showed abnormal blood pressure values during the annual examination, compared to 36.1% of diabetic older adults and 18.3% of general older adults. (3) Blood glucose abnormalities were reported by 24.8% of respondents. Among diagnosed diabetics, 60.5% exhibited abnormal glucose levels, compared to 9.7% of hypertensive patients and 8.4% of general older adults. (4) Anemia detection was 2.0% overall, higher in rural areas (2.6% vs. 1.4% urban, P=0.021). Fatty liver detection was 14.7% overall, higher in urban areas (17.2% vs. 12.3% rural, P<0.001). (5) Compared with general older adults, those with hyperglycemia showed 2.66 times higher odds of blood pressure abnormalities; hypertensive and hyperglycemic older adults showed 1.64 and 1.41 times higher odds of dyslipidemia, 2.81 and 2.57 times higher odds of overweight/obesity, and 2.10 and 1.52 times higher odds of fatty liver, respectively. Conversely, anemia detection rates were 0.26 and 0.50 times lower in hypertensive and hyperglycemic older adults. Rural older adults showed 1.29, 1.36, and 1.76 times higher odds of blood pressure abnormalities, glucose abnormalities, and anemia, respectively, but 0.30 times lower odds of fatty liver compared to their urban counterparts.

Conclusion: Health examinations reveal high rates of blood pressure abnormalities. While disease control among hypertensive and diabetic older adults shows improvement, health prevention and treatment in rural areas lag behind urban areas.

Keywords: National basic public health services; Health examinations; Abnormal detection; Older adults

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According to National Bureau of Statistics data, China' s population aged 65 and older reached 201 million by the end of 2021, accounting for 14.20% of the total population. Population aging continues to intensify while health literacy remains generally low among older adults, with chronic disease risks increasing substantially. The prevalence of chronic diseases among middle-aged and older adults in China reached 43% during 2016–2019. In response, the government has prioritized older adult health, implementing the Basic Public Health Service Program in 2009. By 2022, per capita fiscal subsidies for basic public health services had increased from 15 yuan to 84 yuan. The health management service for adults aged 65+ constitutes a critical component, primarily featuring annual health examinations. Primary healthcare institutions invest substantial human, material, and time resources in these examinations with the primary goal of early detection, diagnosis, and treatment of common geriatric health problems to reduce risks of severe chronic diseases. Health examinations represent a crucial "early detection" link, making both abnormal findings and participants' awareness of these findings key indicators of service effectiveness. While previous research has examined utilization rates, satisfaction, and perceived benefits of older adult health management, this study focuses specifically on abnormal detection rates in health examinations within the basic public health service framework to evaluate program effectiveness from the demand-side perspective.

1.1 Study Subjects

We employed multi-stage stratified sampling: (1) Selected three representative provinces across eastern (Zhejiang), central (Shanxi), and western (Chongqing) regions; (2) Within each province, chose one economically developed and one less-developed city/district/county; (3) Within each selected city, chose one urban district and one rural county; (4) Randomly selected at least two primary healthcare institutions from each district/county. This yielded 20 primary healthcare institutions across 3 provinces and 5 cities as survey sites.

Inclusion criteria were: age $ $65 years, local resident, having received national basic public health services, relatively good cognition and memory, no hearing or language communication barriers, willingness to participate, and signed informed consent. We excluded individuals with unclear recall of their current year' s examination results. Based on basic public health service characteristics, participants were categorized as general older adults, hypertensive older adults, or diabetic older adults. General older adults were defined as those aged $ $65 self-reporting no hypertension or diabetes (though other diseases were possible). Hypertensive or diabetic older adults were those aged $ $65 self-reporting these conditions. Using α=0.05, Z=1.96, allowable error δ=3%, and population standard deviation of 0.5, the minimum required sample size was calculated as 1,067.

The final valid sample comprised 3,018 participants (eastern region: 1,170; central: 1,230; western: 618). Some missing data existed in returned questionnaires; questionnaires with <2% missing data were defined as valid. All participants provided informed consent.

1.2 Research Methods

In 2019, we used a self-designed "National Basic Public Health Service Demand-side Survey Questionnaire." Questionnaire items were developed based on the "National Basic Public Health Service Survey Standards (3rd Edition)" and relevant literature. The instrument included three sub-questionnaires: for hypertensive older adults, diabetic older adults, and general older adults, with Cronbach' s alpha coefficients of 0.89, 0.88, and 0.84, respectively. Content covered demographic characteristics, health examination effectiveness, and abnormal detection rates. Demographic items included age, gender, and annual household income.

Measurement indicators: Abnormal detection rate = (Number of individuals with one or more health problems identified in basic public health service examinations) / (Total survey population). Participants were asked: "Have community health centers (township hospitals) ever helped you discover health problems through annual physical examinations?" Specific abnormal findings were assessed through: "What diseases have you discovered through health examinations?" with options for common geriatric conditions: (1) blood pressure abnormality, (2) blood glucose abnormality, (3) blood lipid abnormality, (4) overweight/obesity, (5) anemia, (6) gallstones or cholecystitis, (7) fatty liver, (8) kidney stones, (9) heart disease, (10) tumors, (11) others. For hypertensive participants, blood pressure abnormality detection rate (indicating control rate) was defined as abnormal if diastolic pressure $ $140mmHg or systolic pressure $ $90mmHg. For diabetic participants, blood glucose abnormality detection rate (indicating control rate) was defined as abnormal if fasting glucose was outside 3.9-6.1mmol/L.

1.3 Quality Control

Investigators received unified training to minimize interviewer bias. After questionnaire collection, a double-entry system was implemented by the survey company to ensure data completeness and accuracy.

1.4 Statistical Methods

We used SPSS 20.0 for descriptive analysis of the Excel database from the survey company to examine participant characteristics. Chi-square tests compared rates across multiple groups, with Bonferroni correction applied for pairwise comparisons when overall significance was found. Multivariate logistic regression analysis identified risk factors for abnormal detection rates. All tests were two-sided with α=0.05.

2.1 Basic Characteristics

The study included 3,018 valid questionnaires: 617 general older adults (20.4%), 1,490 hypertensive older adults (49.4%), and 911 diabetic older adults (30.2%). The sample comprised 1,355 men (45.3%) and 1,638 women (54.7%); 1,500 urban residents (49.7%) and 1,518 rural residents (50.3%). Regional distribution was 38.8% eastern, 40.7% central, and 20.5% western. Age distribution was: 65-74 years (2,101), 75-84 years (795), 85-94 years (119), and $ $95 years (3).

2.2 Self-Reported Abnormal Detection Rates in Health Examinations

The overall abnormal detection rate was 67.4%, significantly higher among rural older adults (70.6%) than urban (64.1%, P<0.001). Local household registration was associated with higher detection rates (67.9% vs. 59.6% for non-local, P=0.016). Western provinces showed lower detection rates (58.7%) compared to eastern (69.7%) and central (69.4%) provinces (P<0.001). Detection rates differed significantly across the three participant categories: 77.7% for hypertensive, 61.4% for general, and 54.4% for diabetic older adults (P<0.001).

2.3 Specific Abnormal Detection Patterns

Blood pressure abnormalities were the most common finding, with 38.9% of respondents self-reporting abnormal blood pressure in their most recent annual examination (rural: 41.2% vs. urban: 36.6%, P=0.010). Among previously diagnosed hypertensive patients, 49.1% showed abnormal blood pressure values, compared to 36.1% of diabetic older adults and 18.3% of general older adults. Blood glucose abnormalities were reported by 24.8% overall, with 60.5% of diagnosed diabetics showing abnormal values, compared to 9.7% of hypertensive and 8.4% of general older adults. Dyslipidemia detection was 23.8% overall, with rates of 26.3% in hypertensive, 23.8% in diabetic, and 17.8% in general older adults. Hypertensive older adults showed higher fatty liver detection rates than general and diabetic older adults (P<0.001). General older adults had lower overweight/obesity detection (6.0%) compared to hypertensive (17.9%) and diabetic (13.3%) groups (P<0.001). Anemia detection was higher in general older adults (4.2%) than in hypertensive (1.1%) and diabetic (2.0%) groups (P<0.001).

2.3.1 Urban-Rural Disparities in Abnormal Detection Rural older adults showed higher detection rates for blood pressure abnormalities (41.2% vs. 36.6% urban, P=0.010) and anemia (2.6% vs. 1.4% urban, P=0.021). Conversely, urban older adults had higher fatty liver detection rates (17.2% vs. 12.3% rural, P<0.001).

2.3.2 Regional Variations in Abnormal Detection Blood glucose abnormalities showed no significant regional differences. However, central provinces exhibited higher dyslipidemia rates (30.6%) compared to eastern (22.1%) and

western (13.8%) provinces (P<0.001). Central provinces also showed higher overweight/obesity detection (17.8% vs. 10.4% eastern, 8.4% western, P<0.001). Blood pressure abnormalities were lowest in central provinces (33.4%), as was anemia detection (1.1%, P<0.005). Eastern provinces showed higher rates of gallstones/cholecystitis (12.1%) and other abnormalities (16.4%) compared to other regions (P<0.001). Western provinces had the lowest fatty liver detection (6.1% vs. 18.6% eastern, 15.4% central, P<0.001).

2.4 Multivariate Analysis of Abnormal Detection Rates

Multivariate logistic regression revealed that, compared to general older adults, those with hyperglycemia had 2.66 times higher odds of blood pressure abnormalities. Hypertensive and hyperglycemic older adults showed 1.64 and 1.41 times higher odds of dyslipidemia, 2.81 and 2.57 times higher odds of overweight/obesity, and 2.10 and 1.52 times higher odds of fatty liver, respectively. Conversely, hypertensive and hyperglycemic older adults had 0.26 and 0.50 times lower odds of anemia. Compared to urban residents, rural older adults had 1.29, 1.36, and 1.76 times higher odds of blood pressure abnormalities, glucose abnormalities, and anemia, respectively, but 0.30 times lower odds of fatty liver.

Discussion

This study found that blood pressure abnormalities were the most common abnormal finding, with 38.9% of respondents self-reporting abnormal blood pressure in their most recent annual examination. Among diabetic older adults, 36.1% showed abnormal blood pressure values, while 24.8% of all respondents reported glucose abnormalities and 9.7% of hypertensive older adults showed abnormal glucose levels. Globally, hypertension prevalence and disease burden continue to rise, with BMI and unhealthy lifestyle factors increasing blood pressure risks. Research indicates that elevated glucose, lipids, and fatty liver are all hypertension risk factors, suggesting that hypertension and hyperglycemia may co-occur and require integrated chronic disease management.

The Healthy China Action (2019-2030) emphasizes strengthening primary prevention of hypertension to prevent cardiovascular disease development, initiating comprehensive hypertension control policies and health actions. Our findings confirm hypertension as the primary health concern for older adults, increasing detection of related conditions. By 2019, China had approximately 245 million adults with hypertension, with prevalence rising 50% among those aged 69+. This underscores the need for increased public health investment in hypertension prevention, improved primary healthcare service capacity, and continued implementation of the National Basic Public Health Service Standards for older adult health.

Notably, 18.3% of general older adults discovered abnormal blood pressure values in their most recent examination, and 8.4% of general older adults were

screened for abnormal glucose, demonstrating that free health examinations effectively identify potential hypertension and diabetes cases. As a chronic disease screening tool, health examinations enable "three early prevention" (early detection, diagnosis, and treatment), allowing timely intervention and lifestyle modifications to slow disease progression and delay complications before symptoms manifest.

Among previously diagnosed hypertensive patients, 49.1% showed abnormal blood pressure values during annual examinations, while 60.5% of diabetic older adults exhibited abnormal glucose levels, indicating disease control rates of approximately 49.1% and 60.5%, respectively. Other studies reported hypertension control rates of only 22.67% in 2015 and diabetes control rates of 42.8% in Shandong in 2017, suggesting that basic public health service implementation has improved chronic disease control over time. Primary healthcare institutions provide standardized, targeted health guidance and interventions that improve health literacy, increase disease awareness, and enhance treatment adherence, enabling patients to take effective measures to maintain normal blood pressure and glucose levels.

The overall abnormal detection rate was 67.4%, with rural older adults showing higher rates than urban residents. Specifically, rural older adults had 1.29, 1.36, and 1.76 times higher odds of blood pressure abnormalities, glucose abnormalities, and anemia, respectively, but 0.30 times lower odds of fatty liver. Other research confirms that urban hypertensive patients have higher awareness, treatment, and control rates than rural patients. Several factors explain these disparities. First, rural older adults generally have lower health literacy; some avoid examinations due to fear of discovering serious conditions. Limited economic development and healthcare accessibility in rural areas mean chronic diseases may not prompt immediate medical attention, making the annual free examination a crucial health discovery channel. Consequently, complications like heart disease may already be present at detection. In contrast, urban areas offer more comprehensive healthcare facilities, higher medical standards, and more extensive health education, enabling earlier disease detection, control, and treatment, potentially resulting in better-controlled chronic conditions during examinations. Second, urban lifestyles—including unhealthy diets, sedentary behavior, and higher obesity rates—contribute to higher fatty liver detection, while nutritional factors may explain higher anemia rates in rural areas.

Both the Healthy China Strategy and Rural Revitalization Strategy emphasize building healthy rural communities. Therefore, optimizing urban-rural healthcare resource allocation, improving diagnostic capacity in rural primary care facilities, strengthening health education and management for rural older adults, and enhancing health literacy are essential for reducing chronic disease burden and building healthy rural areas.

In conclusion, health examinations for adults aged 65+ reveal high rates of blood pressure abnormalities. While disease control among hypertensive and diabetic older adults has improved, rural health prevention and treatment lag

behind urban areas. We must continue improving health literacy among older adults, with particular attention to chronic disease prevention implementation and disease awareness in rural populations.

This study has several limitations: (1) Multi-stage stratified sampling is not strictly random, potentially introducing selection bias; (2) Age and population mixing may affect comparisons, as the distribution of the three participant categories varied across provinces, potentially inflating or deflating certain abnormal detection rates; (3) Abnormal detection data were self-reported, introducing potential recall bias and information bias if examination results were not communicated to patients.

Author Contributions

Li Mengyu, You Lili, and Liu Yuanli conceptualized the study, analyzed and interpreted results, and revised the manuscript, assuming overall responsibility and supervision. You Lili, Li Mengyu, and Lian Juan implemented the study and conducted feasibility analysis and data collection. Li Mengyu, Liao Zirui, and Zan Ziqing managed data. Li Mengyu and Liu Lu performed statistical analysis. Li Mengyu drafted the manuscript. Liu Yuanli, You Lili, Li Mengyu, and Lian Juan controlled quality and reviewed the manuscript.

Conflict of Interest

The authors declare no conflict of interest.

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Note: Figure translations are in progress. See original paper for figures.