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A Post-print Study on the Impact of Non-medical Prescriptions on the Progression of Diabetes Comorbidities in Middle-aged and Elderly Populations

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Abstract

Abstract

Background: Against the backdrop of population aging and the rapid rise in diabetes prevalence, middle-aged and elderly patients with diabetes face a heavy burden of multimorbidity. Systematic evidence regarding the long-term role and mechanisms of non-medical prescriptions in delaying the progression of diabetic multimorbidity remains scarce.

Objective: To analyze the changes in non-medical prescription issuance and glycemic control among middle-aged and elderly patients with diabetic multimorbidity, and to evaluate the role of non-medical prescriptions in delaying the progression of diabetic multimorbidity and its mediating mechanisms.

Methods: A total of 1,731 middle-aged and elderly patients with diabetic multimorbidity aged ≥ 45 years were selected from four waves of the China Health and Retirement Longitudinal Study (CHARLS) data (2011, 2013, 2015, and 2018) to construct a dynamic cohort. The study analyzed trends in multimorbidity burden and patterns, non-medical prescription issuance, and glycemic control. Logistic regression was used to analyze the impact of physicians issuing any non-medical prescription on whether the patient' s multimorbidity increased in the subsequent period. A Generalized Structural Equation Model (GSEM) was employed to test the mediating effect of glycemic control.

Results: The average age of the 1,731 patients in this study was (60.4 ± 9.0) years, with 42.9% (742 cases) aged between 55 and 64 years. 85.3% (1,476 cases) had an education level of junior high school or below, and rural residents accounted for 46.6% (775 cases). During the follow-up period, the prevalence

of multimorbidity among middle-aged and elderly patients with diabetes rose from 87.1% at baseline to 96.7% at the end of follow-up, and the average number of comorbidities (including diabetes) increased from 3.3 (2.0, 4.0) to 4.9 (3.0, 6.0). The issuance rate of various non-medical prescriptions across different follow-up rounds was $\geq$ 90.0% and gradually increased during the follow-up period, from 92.7% at F0 to 100.0% at F3. Among the various types of prescriptions, dietary prescriptions (432 cases, 66.0%) and exercise prescriptions (376 cases, 57.4%) had the highest issuance rates, while the growth rate of foot care prescriptions was significant (increasing from 12.3% to 26.7%). The glycemic control rate decreased from 76.3% (489 cases) to 66.0% (479 cases). Logistic regression and GSEM results showed that physicians issuing non-medical prescriptions could significantly reduce the risk of increased multimorbidity in the next period [$OR_{\text{total multimorbidity}} = 0.666$, Traditional Concordant Comorbidity (TCC) $OR = 0.507$]. Non-medical prescriptions can significantly improve glycemic control levels, thereby reducing the probability of an increase in overall multimorbidity (mediating effect $\beta = -0.850$, 95% CI = -1.583 to -0.116) and reducing the probability of an increase in TCC pattern multimorbidity (mediating effect $\beta = -2.901$, 95% CI = -5.262 to -0.549).

Conclusion: The multimorbidity burden of middle-aged and elderly patients with diabetes continuously intensifies as the disease duration lengthens, with multimorbidity patterns becoming increasingly complex and overall glycemic control levels declining, particularly in the population with multiple comorbidities. As an important intervention in comprehensive diabetes management, non-medical prescriptions can partially offset the adverse effects of multimorbidity accumulation by improving glycemic control, thereby delaying the occurrence and progression of multimorbidity.

Full Text

Impact of Non-Medical Prescriptions on the Progression of Multimorbidity in Middle-Aged and Elderly Patients with Diabetes

Abstract

Objective: To investigate the impact of non-medical prescriptions (lifestyle interventions) on the progression of multimorbidity in middle-aged and elderly patients with diabetes, providing a scientific basis for the integrated management of chronic diseases.

Methods: This study utilized longitudinal data from the China Health and Retirement Longitudinal Study (CHARLS) involving 1,731 middle-aged and elderly patients (aged $\geq$ 45 years) with diabetic comorbidities across four waves (2011, 2013, 2015, and 2018). Non-medical prescriptions were defined as structured recommendations involving physical activity, dietary modifications, and foot care. The progression of multimorbidity was assessed by tracking the inci-

dence of new chronic conditions. Statistical analyses, including Logistic regression and Generalized Structural Equation Models (GSEM), were employed to evaluate the association between adherence to non-medical prescriptions and the risk of developing additional comorbidities, with glycemic control as a potential mediator.

Results: The prevalence of multimorbidity rose from 87.1% at baseline to 96.7% by the end of the study, with the average number of comorbidities increasing from 3.3 to 4.9. While the issuance rate of non-medical prescriptions remained high ($\geq 90.0\%$), the glycemic control rate declined from 76.3% to 66.0%. Analysis indicated that physician-issued non-medical prescriptions significantly reduced the risk of an increase in comorbidities (Total Multimorbidity $OR = 0.666$; Traditional Concordant Comorbidity $OR = 0.507$). Furthermore, non-medical prescriptions significantly improved blood glucose control, which mediated the reduction in comorbidity progression (mediation effect $= -0.850, 95\% CI : -1.583$ to -0.116).

Conclusion: Non-medical prescriptions are effective in slowing the progression of multimorbidity in middle-aged and elderly patients with diabetes by improving glycemic control. Integrating these lifestyle interventions into primary care settings is essential for improving long-term health outcomes.

Keywords: Diabetes; Chronic disease comorbidity; Non-medical prescription; Glycemic control; Mediating effect

Introduction

Diabetes mellitus is a major global health challenge, particularly among middle-aged and elderly populations. Driven by economic development, an accelerating aging population, and shifting lifestyles, the prevalence of diabetes in China has risen sharply. Data indicate that the number of adult diabetes cases in China surged from 22 million in 2000 to 140 million in 2021, ranking first globally.

As a lifelong metabolic disorder, patients with diabetes are particularly susceptible to multiple chronic conditions (MCCs). Sustained hyperglycemia leads to microvascular and macrovascular damage, affecting multiple organs including the heart, kidneys, and peripheral nerves. Research demonstrates that over 80% of diabetes patients are affected by varying degrees of comorbidity, a proportion that increases with age and disease duration [**?**]. Compared to those with diabetes alone, patients with comorbidities face the triple challenges of "multiple concurrent diseases," "multiple symptoms," and "polypharmacy," leading to higher healthcare utilization and a heavier economic burden.

In recent years, "non-medical prescriptions" (also known as lifestyle medicine) —including dietary guidance, exercise prescriptions, and foot care—have gained attention as a vital intervention in comprehensive diabetes management [**?**].

While studies have shown their positive effects on metabolic indicators, empirical evidence regarding their specific impact on the long-term trajectory of multimorbidity in diabetic patients remains limited. This study utilizes data from the China Health and Retirement Longitudinal Study (CHARLS) from 2011 to 2018 to analyze the longitudinal effects of non-medical prescriptions on disease progression in this vulnerable demographic.

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1 Materials and Methods

1.1 Data Source and Study Population

The study utilized data from the China Health and Retirement Longitudinal Study (CHARLS), a multi-stage, stratified, probability-proportional-to-size (PPS) sampling survey of Chinese residents aged 45 and older. We utilized four waves of data (2011, 2013, 2015, and 2018). A dynamic cohort was constructed by selecting 1,731 middle-aged and elderly patients with comorbid diabetes who had at least two follow-up records. The baseline (F_0) was defined as the survey year in which the patient first self-reported comorbid diabetes.

1.2 Definition of Core Concepts

Diabetic comorbidity was defined as a patient having at least one other chronic disease (out of 13 surveyed conditions such as hypertension, heart disease, or kidney disease) in addition to diabetes [**?**]. Comorbidities were categorized into three patterns [**?**, **?**]: 1. **Traditional Concordant Comorbidities (TCC):** Explicit complications like heart disease, stroke, and kidney disease. 2. **Non-traditional Concordant Comorbidities (NCC):** Shared risk factors like hypertension and dyslipidemia. 3. **Discordant Comorbidities (DC):** No direct etiological link, such as arthritis or digestive diseases.

Non-medical prescription variables were derived from self-reported health education or advice received from medical staff regarding weight control, exercise, diet, and foot care. Blood glucose control was assessed via self-report and cross-validated with glycated hemoglobin (HbA_{1c}) data where available.

1.3 Statistical Methods

Statistical analysis was performed using Stata 17.0. Categorical data are expressed as frequencies and percentages. Logistic regression was employed to examine the impact of physician-issued non-medical prescriptions at time t on the increase of comorbidities at time $t+1$. A Generalized Structural Equation Model (GSEM) was utilized to test the mediating effect of blood glucose control. Inverse probability weighting (IPW) was applied to control for selection bias caused by attrition.

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2 Results

2.1 Baseline Characteristics

The mean age of the 1,731 patients was 60.4 ± 9.0 years, with 42.9% aged 55-64. Female patients accounted for 58.1%, and 85.3% had an education level of junior high school or below. Rural residents comprised 46.6% of the sample. Detailed characteristics are provided in .

2.2 Changes in Comorbidity Burden and Patterns

The comorbidity burden increased continuously. Prevalence rose from 87.1% at F_0 to 96.7% at F_3. The average number of comorbid conditions (excluding diabetes) increased from 3.3 to 4.9. Specifically, TCC prevalence rose from 43.5% to 63.4%, and NCC prevalence rose from 78.1% to 89.6% .

2.3 Provision of Non-Medical Prescriptions and Glycemic Control

The provision rate of non-medical prescriptions remained $\geq 90.0\%$ and increased to 100.0% by F_3. Dietary (66.0%) and exercise (57.4%) prescriptions were most common, while foot care prescriptions showed the fastest growth (12.3% to 26.7%) . Conversely, the glycemic control rate declined from 76.3% to 66.0%, with the lowest rates observed in patients with ≥ 5 comorbidities (60.1%) .

2.4 Impact and Mechanism of Non-Medical Prescriptions

GSEM results indicated that patients receiving non-medical prescriptions had a 33.4% lower probability of an increase in overall comorbidity ($OR = 0.666, 95\%CI$: 0.461-0.961) and a 49.3% lower probability of an increase in the TCC pattern ($OR = 0.507, 95\%CI$: 0.280-0.918). Non-medical prescriptions significantly improved blood glucose control ($OR = 4.502$), which in turn reduced the probability of comorbidity progression (mediation effect for total multimorbidity $= -0.850, 95\%CI$: -1.583 to -0.116) [TABLE:6, FIGURE:1].

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3 Discussion

This study demonstrates that the comorbidity burden among middle-aged and elderly patients with diabetes in China is intensifying, with nearly 97% of patients affected by the end of the follow-up. The increasing complexity of disease patterns, especially the rise in cardio-renal (TCC) comorbidities, highlights the systemic impact of chronic hyperglycemia [**?**].

A critical finding is that while glycemic control generally deteriorates as comorbidities accumulate, non-medical prescriptions issued by physicians can significantly delay this progression. The mediation analysis confirms that these lifestyle interventions work primarily by stabilizing blood glucose levels, which

mitigates the risk of further complications. This aligns with the "Daqing Study," which showed that long-term lifestyle interventions reduce cardiovascular events in diabetic populations [**?**].

Despite the high coverage of health education, the quality and personalization of non-medical prescriptions in primary care remain challenges. Consultation times in China are often too short to provide tailored guidance [**?**]. Future management should leverage digital health and AI to provide individualized prescriptions, enhancing patient adherence and long-term efficacy.

3.1 Limitations

The study relies partly on self-reported data for glycemic control and non-medical prescriptions, which may introduce recall bias. Additionally, as an observational study, residual confounding from unobserved variables like dietary structure or exercise intensity may exist.

3.2 Conclusion

Non-medical prescriptions are a vital, scalable tool for managing diabetic multimorbidity. By improving glycemic control, these interventions slow the progression of chronic conditions, particularly cardiovascular and renal complications. Strengthening the role of general practitioners in delivering personalized lifestyle guidance is essential for reducing the long-term burden of diabetes in China.

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

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