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Analysis of the Development Trends of Preschool Population and the Demand for Preschool Education Resources under the New Population Situation: Taking Beijing as an example

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Abstract: The development of preschool education has become an important task in the development of education in China. However, under the trend of fewer children and changes in new population policies, the development trend of preschool education population and the demand for semester education resources in China are not clear, which brings many challenges to the allocation of future education resources. This study uses a Population Development Environment Analysis (PDE) model to predict the demand for educational resources among the preschool population in Beijing from 2020 to 2040. The research results show that during the prediction period, the scale of education eligible young children, the scale of preschool children in the first three years, the scale of kindergarten buildings, and the demand for full-time teachers and caregivers all show a trend of first increasing and then decreasing. The demand for education funds and per capita funds is gradually increasing. The future allocation of preschool education resources needs to be adjusted reasonably based on the actual needs and usage of resources. After investing heavily in the allocation of preschool education resources, attention should be paid to the relative surplus of resources caused by the subsequent decrease in resource demand.

Keywords: New population trends; The demand for preschool education resources; Multi-state population prediction model

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1. Introduction

High-quality preschool education is an effective way to enhance human capital and is closely linked to the future of the country and nation [1–6]. This study uses a multi-state population prediction model based on the revision of base period data, combined with existing research results on future fertility levels, mortality levels, migration levels and education transformation, to predict the appropriate age population and corresponding educational resource demand increment in Beijing under the new population situation. This provides a reference

for scientifically adjusting Beijing's education planning, kindergarten facilities, teaching staff and quantity and quality construction.

2. Materials and methods

2.1. Research data and prediction parameter settings

Base period data: This study uses the population data of Beijing from the 7th National Population Census in 2020 (hereinafter referred to as the Seventh National Population Census Data) as the basic data. Specific indicators include the total population of Beijing by age and gender, the number of deaths, the number of migrants, and the fertility rate of women of childbearing age. The mortality rate and net migration rate are calculated based on the corresponding indicators.

Population fertility rate: This study assumes that, while the existing fertility policy remains unchanged, the following three plans are proposed for future changes in Beijing's fertility level:

(1) Low plan: This study assumes that the relaxation of the national fertility policy will not affect the fertility willingness and rate of the Beijing population and further assumes that the total fertility rate in Beijing will steadily decline from 2020 to 2030, reaching 0.77 by 2030, which is consistent with the predicted level in existing literature [7];

(2) Medium plan: This study assumes that the population of Beijing is not significantly affected by other factors, and the trend of the birth population remains unchanged. That is, it assumes that the total fertility rate in Beijing will remain unchanged at the current level of 0.87 by 2030;

(3) High plan: This study assumes that the relaxation of the national fertility policy will have an impact on the fertility willingness and rate of the population in Beijing, with a significant increase in the birth rate. That is to say, it is assumed that the total fertility rate in Beijing will steadily increase from 2020 to 2030, reaching 1.2 by 2030, and then maintain this level unchanged from 2030 to 2040 [8,9].

Life expectancy of the population: According to data from the National Bureau of Statistics, the life expectancy of males in Beijing in 2020 was 80.04 years old, and that of females in Beijing was 84.9 years old. In the prediction process, due to the low mortality rate in Beijing in 2020, which was 4.59 %, and the basic maintenance of the mortality rate in Beijing from 2016 to 2019 was around 5.5 %. Therefore, considering the population mortality rate in Beijing from 2015 to 2019 and 2021, as well as external factors such as underreporting, this study took the average mortality rate in Beijing in 2019 (5.49 %) and 2021 (5.39 %) and obtained a mortality rate of 5.44 % in Beijing in 2020. According to existing literature predictions, the life expectancy of the population in Beijing by 2030 is 82.74 years old for males and 88.90 years old for females.

Population migration rate: In 2020, the net migration population in Beijing was 1.279 million people. According to the seventh national census data, the permanent resident population in Beijing was basically controlled at 22 million in 2020. This study assumes that the incoming and outgoing population in Beijing will be equal in 2025, with a net migration population of 0. The net migration population in 2030 is -500,000, which means that the outflow population is 500,000 more than the inflow population. Maintaining this migration scale unchanged after 2030 is necessary to maintain the total population of Beijing at around 23 million by 2030.

2.2. Research methods

The Population Development Environment Analysis (PDE) model, also known as the Population Development Environment model, is a prediction model based on queue composition prediction methods and the application of a multi-state life table. It divides the population into different "states" based on age, gender, education level and region [10–13] and predicts the size of the birth cohort and the educational transition of the population

with different education levels in a certain region under the influence of death, childbirth and net population migration during the prediction period [14].

3. Research results

3.1. Prediction of demand for preschool education resources and analysis of supply-demand contradictions

This study calculated the size of each kindergarten with 6 classes and 30 students according to the standard of kindergarten building allocation. The results show that similar to the trend of changes in the scale of preschool education in kindergartens, the demand for preschool education facilities in Beijing showed a trend of first increasing and then decreasing from 2020 to 2040. Among them, the demand for resources reached its peak in 2025, ranging from 3600 to 3800. From 2025 to 2035, the demand for preschool education facilities in Beijing began to rapidly decline. According to the low plan assumption, the demand for preschool education facilities in Beijing will be 1460 in 2035. According to the medium plan assumption, the demand for preschool education facilities in Beijing will be 1645 in 2035. According to the high plan assumption, the demand for preschool education facilities in Beijing will be 2294 in 2035, a decrease of more than 1000 compared to 2025. Starting from 2035, the decline in demand for preschool education facilities in Beijing has slightly slowed down. According to data from the National Bureau of Statistics, there were 1899 kindergartens in Beijing in 2020 [15].

3.2. Analysis of the demand and supply-demand contradiction for preschool education teachers

This study will predict the demand for preschool education teachers in Beijing through the teacher-student ratio and analyze the supply-demand contradiction. The results show that similar to the trend of changes in the scale of preschool education in kindergartens, the demand for full-time preschool education teachers in Beijing from 2020 to 2040 showed a trend of first increasing and then decreasing. Among them, the demand scale reached its peak in 2025, with 43,000 to 46,000 people. As shown in the figure, the actual number of full-time teachers in Beijing in 2020 was 22,788, while the demand for full-time teachers in preschool education in Beijing in 2020 was 42,700, with a demand gap of approximately 20,000 people. From 2020 to 2025, this demand gap gradually increases and by 2025, this gap will be 21,000 to 25,000 people. From 2025 to 2035, the demand for full-time preschool education teachers in Beijing began to decline at a relatively fast pace. By 2035, according to the low plan assumption, the demand for full-time preschool education teachers in Beijing is 17,000 people. According to the proposed plan, the demand for full-time preschool education teachers in Beijing is 20,000 people. According to the high plan assumption, the demand for full-time preschool education teachers in Beijing is 27,000 people.

The predicted demand for childcare workers shows that consistent with the trend of changes in the scale of demand for full-time preschool education teachers, the demand for childcare workers in Beijing's preschool education shows a trend of first increasing and then decreasing from 2020 to 2040. In 2020, the supply of childcare workers in Beijing was 11,000, the demand was 21,000, and the shortage of childcare workers was 10,000. From 2020 to 2025, the demand for childcare workers in Beijing gradually increased, reaching a peak of 22,000–23,000 people in 2025, and the gap increased to 11,000–12,000 people. Starting from 2025, the demand for childcare workers in Beijing will begin to decline. By 2035, according to the low plan assumption, the demand for preschool education childcare workers in Beijing will be 8760 people. According to the assumption in the medium plan, the demand for preschool education caregivers in Beijing is 9870 people. According to the high plan assumption, the demand for preschool education caregivers in Beijing is 14,000 people.

3.3. Prediction of preschool education funding demand and analysis of supply-demand contradictions

According to data from the National Bureau of Statistics, the number of preschool children in Beijing in 2020 was 525,900 and the average public budget expenditure on education for kindergarten students reached 3,909,401 yuan. In 2020, Beijing's GDP reached 3610.255 billion yuan. Therefore, this study can calculate that the proportion of preschool education funds to GDP in Beijing in 2020 was 0.57%. The average annual GDP growth rate in Beijing from 2016 to 2020 was 5.52%. This study assumes that the GDP growth rate in Beijing will remain at this rate for the next 15 years. Based on the above data, it can be predicted that the GDP of Beijing in 2025 should be 4.8 trillion yuan, and the funding for preschool education should be 27.502 billion yuan. Therefore, according to the low, medium, and high plans, the average funding for preschool education in Beijing should be 42,000 yuan, 41,600 yuan and 39,800 yuan per student. The GDP of Beijing in 2030 should be 5.8 trillion yuan and the funding for preschool education should be 33.451 billion yuan. Therefore, based on the assumptions of low, medium and high plans, the average funding for preschool education in Beijing should be 73,100 yuan, 69,000 yuan and 57,900 yuan per student. According to the predicted GDP of Beijing in 2035, it is 6.9 trillion yuan, and the funding for preschool education is 39.399 billion yuan. Based on the assumptions of low, medium, and high plans, the average funding for preschool education in Beijing should be 150,000 yuan, 133,000 yuan and 95,400 yuan per student. According to the GDP forecast of Beijing in 2040, it is 8.3 trillion yuan and the funding for preschool education is 47.504 billion yuan. Based on the assumptions of low, medium and high plans, the average funding for preschool education in Beijing should be 283,500 yuan, 243,700 yuan and 162,700 yuan per student.

4. Summary

This study uses the population data of Beijing from the 7th National Population Census in 2020 as the base period data to predict the scale of preschool education eligible children, kindergarten children, enrolled children, kindergarten buildings, the demand for full-time teachers and caregivers and the demand for education funds in Beijing from 2020 to 2040. The study also analyzes the supply-demand contradiction of educational resource allocation. The prediction results show that during the prediction period, the scale of education-eligible children, the scale of preschool children entering kindergarten in the first three years, the scale of kindergarten buildings and the demand for full-time teachers and caregivers all show a trend of first increasing and then decreasing. The scale of preschool children entering kindergarten shows a downward trend in the first and second year of preschool. The demand for education funding and per capita funding is gradually increasing.

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Disclosure statement

The authors declare no conflict of interest.

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