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Current Status of Key Competencies among Medical Students: A Latent Profile Analysis

Mengyao Xiao[1], Li Yan[2], Yongping Xia[1], Li Liu[1*]

[1]School of Public Health, Chongqing Medical University, Chongqing, China
[2]School of Medical Information, Chongqing Medical University, Chongqing, China
Email: *1285476385@qq.com

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Abstract

The purpose of this study was to understand the overall level of key competencies of medical students and explore the potential profile of key competencies, promoting quality education, and improving the quality talent cultivation in medical colleges. A stratified random sampling method selected 734 medical students from four medical colleges in Chongqing Province of China. A general information questionnaire and a key competencies survey questionnaire were used to conduct the survey. The overall score and scores of each dimension of key competencies were analyzed. Latent profile analysis was conducted to classify the key competencies of medical students and compare the distribution differences of demographic variables among different categories. The results showed that 26% of medical students have never heard of the concept of key competencies, and 59% of them are not familiar with the content related to key competencies. The score of key competencies is 3.66 ± 0.60, with the highest score in the dimension of responsibility and the lowest score in the dimension of humanistic accomplishment. The latent profile analysis classified them into three categories: "low key competencies group (14.71%)", "medium key competencies group (36.79%)", and "high key competencies group (48.50%)". The R3STEP regression analysis results showed statistically significant differences in educational level and whether they served as student cadres among different key competencies categories of medical students. This paper discusses three different potential key competencies categories among medical students, and the overall level of key competencies is relatively good. However, medical students lack a comprehensive and systematic understanding of key competencies. Humanistic accomplishment, healthy living, and practical innovation are the three dimensions with lower scores and should be given more attention. Medical colleges should integrate the concept of key competencies into teaching and implement it in medical practice to cultivate more high-quality medical talents for society.

Keywords

Sustainable Education, Medical Students, Key Competencies, Latent Profile Analysis

1. Introduction

The advent of globalization, informatization, and the knowledge economy has put forward new requirements for quality education, especially in terms of the quality and competence of human resources. In this context, international organizations, major countries, and regions have successively carried out research and exploration of students' key competencies. United Nations Educational, Scientific, and Cultural Organization (UNESCO) is one of the international organizations that started the research on key competencies earliest, emphasizing the importance of making students "learn to know", "learn to do", "learn to live together", "learn to be", and "learn to change", which implies the concept of cultivating students' key competencies [1]. The Organization for Economic Cooperation and Development (OECD) launched the Definition and Selection of Competences: Theoretical and Conceptual Foundations (DeSeCo) project in 1997 and published a research report in 2003, officially using the term "key competencies" and establishing the key competencies framework of the OECD [2]. Based on the OECD's framework, the European Union (EU) released the "Key competences for Lifelong Learning: A European Reference Framework" in 2006, which became a guiding guideline for the key competencies cultivation of the EU and its member countries [3].

In 2014, China clearly stated the need to accelerate the construction of the key competencies system [4] and in 2016 released the overall framework and basic connotation of "Chinese Student Development Key Competencies", and it pointed out that key competencies refer to the essential qualities and key abilities gradually formed to meet the needs of personal lifelong development and social development, and are a combination of requirements related to students' knowledge, skills, emotions, attitudes, values, and other aspects [5]. Research on key competencies is not only the fundamental task of implementing moral education but also provides new ideas and motivation for talent cultivation in China, playing a leading role in improving the quality of talent cultivation. During the important period of accelerating quality education and the high-quality development of medical education, improving the quality of medical talent cultivation will be the core task of medical colleges, and cultivating medical talents that meet the requirements of key competencies goals has also become an important mission of quality education medical education [5].

Currently, research on key competencies in China mostly focuses on basic education, with less attention to higher education [6]. Moreover, existing research is mainly theoretical, with fewer empirical studies, and the research often

divides the key competencies level of the subjects based on scores [5] [7] [8], failing to reflect the heterogeneity of key competencies among individuals with the same score in different dimensions. Latent Profile Analysis (LPA) can classify individuals based on the similarity of their profiles, providing a more objective classification result [9]. This study aims to investigate the key competencies of medical students and explore the types of key competencies using latent profile analysis. It also analyzes the characteristics of key competencies among different groups and provides a reference for improving the level of key competencies among medical students, optimizing talent training programs, and enhancing the quality of talent cultivation.

2. Materials and Methods

2.1. Participants

The research group was surveyed from March to April 2023, and a stratified random sampling method was used to recruit the participants. Four medical colleges in Chongqing Province of China were selected as the sample collection area, and medical students from these colleges were chosen as the research subjects, which were divided into three levels: junior college, undergraduate, and postgraduate, according to their educational levels. The questionnaire was anonymous and self-administered to the participants whose participation in the study was voluntary, and a total of 734 valid questionnaires were collected.

2.2. Survey Questionnaire

The questionnaire was constructed on the Questionnaire Star platform (https://www.wjx.cn/), a free platform widely used for surveys in China, which creates an internet link to the questionnaire. Members of the research team sent the questionnaire to the counselors who agreed to participate in this survey. The counselors then invited students to participate in this survey.

The questionnaire consisted of three parts. The first part was the introduction. It briefly described the purpose of the survey and also included an informed consent statement, which informed participants of their rights, and informed them that the survey was voluntary and anonymous, that the survey data would be used for research purposes only, and that participants are considered informed and consent to participate in the study by submitting a questionnaire.

The second part was general information, including educational level, major, ethnic group, household registration, whether they serve as student cadres, and their knowledge of key competencies.

The third part included a self-administered key competencies questionnaire, which consists of 34 items. Developed by the research team, the questionnaire was based on the overall framework of "Chinese Student Development Key Competencies" (2016) [10], according to the six dimensions of the framework, observation point questions were designed, and the questionnaire was finalized through expert consultation, pre-surveys, and screening of entries. The Likert

5-point scoring method was used, and the Cronbach's α coefficient for this study was 0.925.

2.3. Statistical Analysis

Latent profile analysis (LPA) is an individual-centered statistical analysis method that uses probability models for estimating and comparing probabilities, fitting indicators and statistical tests to determine the various categories to be able to identify different characteristics among individuals through different responses to scale entries and classify the sample based on the different characteristics to determine the subgroups contained in the sample population and test the relationship of the variables in the different groups.

SPSS 25.0 and Mplus 8.0 software were used for data analysis. Firstly, latent profile analysis was conducted using Mplus 8.0 software. The model fit and an optimal number of categories were determined by three types of fit indices: 1) Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC), and Adjusted Bayesian Information Criteria (aBIC). Lower values of these indices indicate better model fit [11]. 2) Entropy, ranging from 0 to 1, was used to assess classification accuracy [12]. 3) The Lo-Mendell-Rubin (LMR) and bootstrap likelihood ratio test (BLRT), corresponds to a significant p-value ($p < 0.05$) when it indicates that the model fit is better for k categories than for the $k - 1$ categories model [13]. Secondly, SPSS 25.0 software was used for data analysis. Frequency and composition ratio were used to describe categorical variables, and the overall scores and scores of each dimension of the questionnaire were described ($\overline{x} \pm s$). Based on the determined optimal profile model, intergroup comparisons of key competencies scores were conducted, and chi-square tests were used for comparisons of categorical variables among multiple groups, with a significance level of $p < 0.05$. Lastly, R3STEP regression analysis in Mplus 8.0 software was used to analyze demographic factors [14] [15].

3. Results

3.1. Descriptive Analysis

There were 250 male students (34.1%) and 484 female students (65.9%) in this survey; 336 specialists (45.8%), 262 undergraduates (35.7%), and 136 postgraduates (18.5%), which is basically in line with the size of the number of medical students at all training levels in Chongqing Province of China.

This study surveyed the knowledge of key competencies among medical students, the results are shown in **Figure 1**, which found that 59% of medical students have heard of key competencies but are not familiar with their content. Only 15% of medical students are aware of key competencies and their related content, while 26% of medical students have never heard of key competencies, indicating a lack of comprehensive understanding of key competencies among medical students.

The survey results show that the overall score of key competencies among

medical students in Chongqing is 3.66, indicating a relatively good overall situation. Looking at the scores of the six dimensions, the dimension of responsibility has the highest score, significantly higher than the other five dimensions. The dimension of humanistic accomplishment has the lowest score, and the dimensions of healthy living and practical innovation also have relatively low scores, below the overall average, as Table 1 shows.

3.2. Identifying Potential Profiles of Key Competencies of Medical Students

Based on the six dimensions of the key competencies questionnaire, latent profile analysis was conducted to classify the key competencies of medical students into different profiles. The model fit results are shown in Table 2. As the number of categories increased, the AIC, BIC, and aBIC decreased gradually, but the rate of decrease slowed down when the number of categories was three, indicating that the fit optimization of the latent profile model decreased as the number of categories increased. Comparing the models with three, four, and five categories, the LMR for five categories did not reach a significant level ($p > 0.05$), and the model entropy was the highest (0.934) for three categories, indicating the highest classification accuracy. Considering all fit indices, the final optimal classification result for the key competencies of medical students was a three-category model.

Based on the classification results of the latent profile model, the average

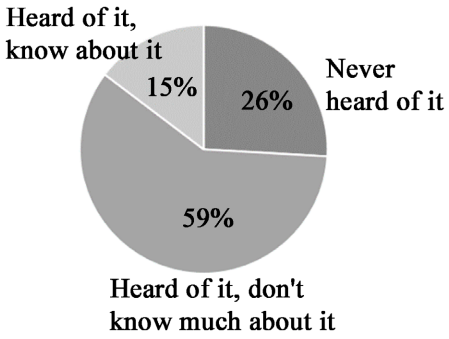

Figure 1. Medical students' knowledge of key competencies.

Table 1. Scores and total scores of each dimension of key competencies.

	Averages	SD
Humanistic accomplishment	3.51	0.70
Scientific spirit	3.74	0.67
Learning to learn	3.67	0.62
Healthy living	3.55	0.71
Responsibility	3.85	0.58
Practical innovations	3.58	0.76
Totals	3.66	0.60

Table 2. Latent profile analysis model fitting information for key competencies of medical students.

Model	AIC	BIC	aBIC	LMRT (p)	BLRT (p)	Entropy	Categorical probability
1	9011.229	9066.411	9028.307	-	-	-	1.00
2	6667.944	6755.316	6694.985	0.000	0.000	0.955	0.45640/0/54360
3	5630.628	5750.189	5667.630	0.000	0.000	0.934	0.14714/0.36785/0.48501
4	5173.633	5325.383	5220.597	0.0313	0.000	0.919	0.13215/0.13760/0.39510/0.33515
5	4928.809	5112.750	4985.737	0.2356	0.000	0.927	0.06276/0.11580/0.13896/0.29564/0.38692

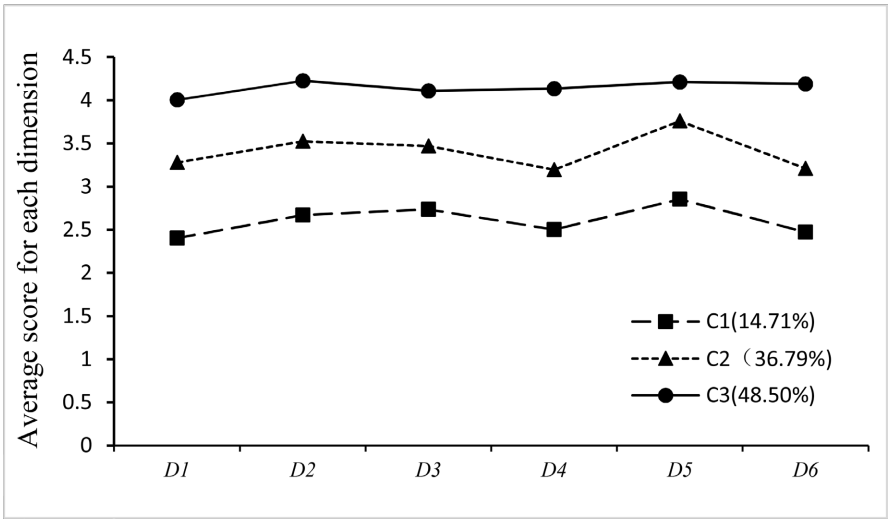

Figure 2. Average scores of three potential categories of key competencies among medical students in six dimensions.

scores of the three categories in the six dimensions of the key competencies questionnaire are shown in Figure 2. Group C1, which accounts for 14.71% of the participants, has the lowest scores in all dimensions and is named the "low key competencies group". Group C2, which accounts for 36.79% of the participants, has scored at a medium level in all dimensions and is named the "medium key competencies group". Group C3, which has the highest scores in all dimensions, accounts for 48.50% of the participants and is named the "high key competencies group".

Differences in key competencies among the three groups were tested, and the results are shown in Table 3. There were statistically significant differences in the scores of the six dimensions of key competencies among medical students in different latent categories ($p < 0.05$). Post-hoc tests showed that the differences in scores between different types of medical students in each dimension of key competencies were also statistically significant. This indicates that the classification can effectively distinguish the level of key competencies among medical students.

3.3. Analysis of Different Medical Student Key Competencies Groups on Demographic Variables

Table 4 shows that there were no statistically significant differences in gender,

Table 3. Comparison of key competencies scores of medical students indifferent potential sections ($\bar{x} \pm s$).

Group	Humanistic accomplishment	Scientific spirit	Learning to learn	Healthy living	Responsibility	Practical innovations
1	2.42 ± 0.438	2.68 ± 0.371	2.74 ± 0.405	2.51 ± 0.335	2.86 ± 0.302	2.48 ± 0.338
2	3.28 ± 0.358	3.53 ± 0.365	3.48 ± 0.433	3.20 ± 0.370	3.76 ± 0.419	3.21 ± 0.407
3	4.01 ± 0.465	4.23 ± 0.400	4.11 ± 0.360	4.13 ± 0.380	4.21 ± 0.311	4.19 ± 0.433
F	638.116***	741.607***	549.047***	993.427***	617.785***	894.953***
Post-hoc tests	1 < 2 < 3	1 < 2 < 3	1 < 2 < 3	1 < 2 < 3	1 < 2 < 3	1 < 2 < 3

Note: 1-low key competencies group, 2-medium key competencies group, 3-high key competencies group; ***Indicates $p < 0.001$.

Table 4. Comparison of medical students' demography data among different key competencies groups.

Socio-demographic characteristics	Low key competencies group	Medium key competencies group	High key competencies group	χ^2	P
Gender (N, %)					
Male	43 (39.8)	91 (33.7)	116 (32.6)	1.953	0.377
Female	65 (60.2)	179 (66.3)	240 (67.4)		
Eeducational level (N, %)					
junior college	77 (71.3)	102 (37.8)	157 (44.1)	48.247	<0.001
undergraduate	27 (25.0)	95 (35.2)	140 (39.3)		
postgraduate	4 (3.7)	73 (27.0)	59 (16.6)		
Major (N, %)					
Public health and preventive medicine	3 (2.8)	37 (13.7)	33 (9.3)	28.195	<0.001
Clinical medicine	40 (37.0)	90 (33.3)	146 (41.0)		
Dental medicine	3 (2.8)	19 (7.0)	20 (5.6)		
Traditional Chinese medicine category[1]	18 (16.7)	65 (24.1)	71 (19.9)		
Others[2]	44 (40.7)	59 (21.9)	86 (24.2)		
Ethnic group (N, %)					
Han ethnic group	92 (85.2)	246 (91.1)	316 (88.8%)	2.879	0.238
Others	16 (14.8))	24 (8.9)	40 (11.2)		
Household registration (N, %)					
Cities and towns	43 (39.8)	143 (53.0)	169 (47.5)	5.561	0.062
Rural	65 (60.2)	127 (47.0)	187 (52.5)		
Serve as student cadres (N, %)					
Yes	62 (57.4)	173 (64.1)	254 (71.3)	8.488	0.014
No	46 (42.6)	97 (35.9)	102 (28.7)		

Note: Traditional Chinese medicine category includes Traditional Chinese Medicine, Integration of traditional Chinese and western medicine, and Chinese Materia Medica; Others include Basic Medical Sciences, Pharmacy, Nursing, Medical technology, and Medical Jurisprudence.

ethnicity, and political affiliation among medical students in different key competency categories. However, there were statistically significant differences in educational level, major, and whether they served as student cadres ($p < 0.05$).

Using different key competencies groups of medical students as the dependent variable (with the high key competencies group as the reference group) and educational level, major, and whether they served as student cadres as independent variables, a mixed regression model was constructed using the R3STEP method, as Table 5 shows. The results show that educational level and whether they served as student cadres have predictive effects on the key competencies categories of medical students. Compared with the high-key competencies group, undergraduate students were less likely to belong to the low-key competencies group ($p = 0.021$, OR = 0.501), postgraduate students were less likely to belong to the low-key competencies group ($p = 0.016$, OR = 0.118), and more likely to belong to the medium key competencies group ($p = 0.023$, OR = 1.786). Students who served as student cadres were less likely to belong to the low-key competencies group ($p = 0.003$, OR = 0.482), and the major did not have a significant effect on the key competencies categories of medical students.

4. Discussion

4.1. Medical Student Key Competencies are at a Good Level with Three Potential Categories

The results of this study showed that the overall score of key competencies among medical students in Chongqing Province of China was (3.66 ± 0.60) points, which was at a relatively good overall level. Based on the six dimensions

Table 5. Regression mixture model results of demography variables to potential categories.

	Low key competencies group				Medium key competencies group			
	B	SE	p	OR (95%CI)	B	SE	p	OR (95%CI)
Educational level								
undergraduate	−0.692	0.299	0.021	0.501 (0.279 - 0.899)	0.016	0.208	0.938	1.016 (0.676 - 1.528)
postgraduate	−2.133	0.888	0.016	0.118 (0.021 - 0.675)	0.580	0.255	0.023	1.786 (1.084 - 2.944)
Major								
Public health and preventive medicine	−0.950	0.781	0.224	0.387 (0.084 - 1.787)	0.194	0.350	0.579	1.214 (0.611 - 2.411)
Clinical medicine	−0.545	0.285	0.056	0.580 (0.332 - 1.014)	−0.118	0.238	0.618	0.889 (0.557 - 1.417)
Dental medicine	−0.685	0.801	0.392	0.504 (0.105 - 2.423)	0.175	0.397	0.659	1.191 (0.547 - 2.594)
Traditional Chinese medicine category	−0.592	0.370	0.110	0.553 (0.268 - 1.142)	0.270	0.261	0.301	1.310 (0.785 - 2.185)
Serve as student cadres								
Yes	−0.73	0.247	0.003	0.482 (0.297 - 0.782)	−0.329	0.185	0.076	0.720 (0.501 - 1.034)

of key competencies, this study used latent profile analysis to identify three potential categories of key competencies among medical students: the "low key competencies group" (14.71%), the "medium key competencies group" (36.79%), and the "high key competencies group" (48.50%). The sum of the proportions of the medium and high key competencies groups exceeded 85%, which indicated that the key competencies of medical students were mostly at a medium level or above, and literacy is mostly above the medium level, which is similar to the results of previous studies [5], indicating that the quality education carried out in medical schools is more effective and the overall core literacy level of medical students is at the middle to the upper level. However, there are significant differences in the scores of key competencies among different categories, indicating individual differences in key competencies among medical students. Quality education should focus on key competencies and adopt targeted measures based on the characteristics of medical students for cultivation.

4.2. Medical Students do not Know Enough About Key Competencies and the Concept of Cultivation Needs to be Strengthened

The survey shows that nearly 60% of medical students are not familiar with the content related to key competencies, and 26% of medical students have never heard of key competencies. This indicates a lack of comprehensive and systematic understanding of key competencies among medical students, mainly due to insufficient promotion of key competencies. On the one hand, compared to other countries and regions, China proposed key competencies relatively late and introduced the overall framework of "Chinese Student Development Key Competencies" in 2016. Key competencies have not been widely promoted in quality education at all stages, resulting in insufficient knowledge and understanding of key competencies among students, and even some teachers have limited understanding of them. On the other hand, the integration of talent training in medical colleges with the concept of key competencies needs to be strengthened. Most medical colleges in China still follow the traditional three- stage teaching model of basic courses, clinical courses, and internships, with unclear positioning of medical talent cultivation. However, the educational concept of key competencies emphasizes the organic integration of individual growth, professional development, and social needs, which helps to scientifically position the goals of professional talent cultivation. Therefore, schools should integrate the concept of key competencies into new teaching models, take moral education as the fundamental task, and cultivate high-quality medical talents with both ethics and abilities.

4.3. Focus on Breaking through Weak Links

4.3.1. Practical Innovations

Both from the scores of all respondents in each dimension and the scores of different categories of medical students in each dimension, the dimension of re-

sponsibility has a relatively high level. Responsibility is the most important competence considered by doctors as well as medical students [16], which indicates that medical schools are more effective in cultivating a sense of responsibility among medical students. During the COVID-19 pandemic, medical students stood at the forefront of the fight against the virus, demonstrating their sense of responsibility and mission. Schools should continue to focus on cultivating medical students' sense of responsibility, which is a long-term process, especially by focusing on improving their practical ability to take responsibility. It is worth noting that this survey found that the level of practical innovation literacy among medical students is not high, indicating that there is still room for improvement in cultivating medical students' practical skills and innovation abilities. A survey of clinical undergraduate students in 2022 found that their self-rated practical ability was low, and their ability scores were lower than their knowledge scores [17]. Undergraduate students lack opportunities for practical operations [18]. Therefore, medical colleges should provide more practical opportunities for medical students, especially in clinical practice. Clinical skills are an important part of medical education [19], and participating in more clinical practice can help improve practical skills [20]. Medical students who participated in volunteer activities and clinical research during the COVID-19 pandemic expressed that research experience is very valuable for their professional development, and thought clinical research internships should be incorporated into medical education [21]. However, in China, clinical skills are mainly taught through lectures, with limited effectiveness [22]. To strengthen the teaching of clinical skills, most medical schools in China have tried innovative teaching methods, such as problem-based learning and simulation teaching, which are considered to improve students' performance in exams and clinical abilities [23] [24].

Moreover, medical students also have insufficient research ability exercise [25], weak scientific research and innovation ability [26], and other problems, which requires institutions to carry out diversified activities to encourage medical students to participate in a variety of innovative practical activities, good training, and guidance is to stimulate students' creativity. In the US, the early introduction of research work and training in innovative thinking can be promoted in innovation education [27]. China's university innovation and entrepreneurship and other scientific research programs have been widely implemented in the undergraduate education system, which provides the feasibility of guiding undergraduates to conduct scientific research, and to a certain extent, bridges the gap of undergraduates' learning in the field of scientific research, laying the foundation for the cultivation of excellent clinicians in the future [28]. At the same time, medical schools should also organize students to go into society and participate in social volunteer services, community health promotion, and other activities. A variety of on- and off-campus practical activities, not only is conducive to enhancing the practical innovation ability of medical students but also helps to cultivate their sense of responsibility in practice, realizing the

win-win situation of "service + learning".

4.3.2. Healthy Living

As future talents in the health industry, medical students should have a healthy lifestyle and good health literacy [29]. However, multiple studies have shown that medical students generally have unhealthy living habits [30], dietary habits [31], and unhealthy lifestyles [32]. One report showed that the overall prevalence of poor sleep quality among Asian medical students was 47.4%, higher than that of students in other majors [33]. Medical students have prominent insomnia problems [34], poor sleep quality [35], and worse sleep quality compared to students in other majors [36]. Moreover, the level of health literacy among medical students is not as high as expected, [37] [38] and difficult for them to apply health-related knowledge to daily practice and deficiencies in health behaviors [39]. Therefore, medical colleges should pay attention to the cultivation of students' health literacy. Health popular science education is one of the important ways to improve students' health literacy. Medical colleges should make full use of their professional advantages to hold health education lectures, offer health education courses, and equip students with good health knowledge and positive health attitudes. Strengthening practical health education for students can help them form good health lifestyles and improve their health literacy.

4.3.3. Humanistic Accomplishment

Students who have exposure to humanities subjects are more likely to become empathetic clinicians [40], they also tend to have better tolerance and emotional resilience [41]. To cultivate medical professionals with compassion, love, and warmth, medical humanities education is essential, common medical humanities courses include history, ethics, narrative medicine, literature, and art [42] [43]. However, in some medical colleges, medical humanities courses are elective or have fewer credits [44], it has also been shown that higher-ranked medical schools seem less likely to offer a medical humanities program [43]. This survey also found that medical students do have some problems with humanistic literacy, with the lowest score of humanistic underlying literacy, and some studies have also shown that the humanistic quality and humanistic caring ability of medical students are generally low [45] [46], and the lack of humanistic caring is very likely to lead to the occurrence of doctor-patient disputes, which is not conducive to the construction of harmonious doctor-patient relationship, thus it can be seen that, although the medical school has been emphasizing the importance of humanistic education, the effectiveness of the results is not as satisfactory as it could have been.

The study of humanities subjects is part of the necessary knowledge for good clinical practice [42]. However, medical education in China is still dominated by natural sciences, with only 7.54% of the curriculum dedicated to humanities, much lower than in European and American countries (20% - 26%). In the clinical education stage, the proportion of relevant courses is only 5% [47]. In addi-

tion, medical humanities courses with medical professional characteristics are not widely offered, and the courses on medical history, medical sociology, and medical philosophy are less than 5% [48]. Therefore, medical colleges should improve the curriculum system of humanities courses and integrate humanistic qualities education into medical professional education. In addition to theoretical teaching, medical humanities education should also be implemented in practice. Including medical humanities training in medical courses is important [49]. Still, in most medical colleges in China, medical education courses lack humanistic care training [50], medical humanities education is limited to the stage of basic theoretical teaching, and students do not consider it an important part of medical practice. On the one hand, teachers should transform traditional theoretical teaching methods, actively involve students in the classroom, and incorporate medical humanities-related learning and practice into clinical teaching courses, helping students apply medical humanities knowledge to clinical practice. On the other hand, schools should organize various humanities practice activities, allowing students to have close contact with the public and patients, and creating opportunities for students to develop their clinical skills and cultivate a sense of empathy through active participation [51], which will help them develop humanistic accomplishment.

5. Conclusions

This study used latent profile analysis to identify three categories of key competencies among medical students and analyzed the differences in demographic variables among different categories. The results provide a reference for talent cultivation in medical colleges. The concept of key competencies should be integrated into medical education, and medical colleges should pay attention to the cultivation of humanistic accomplishment, healthy living, and practical innovation. The cultivation of key competencies should be implemented in medical education practice to cultivate high-quality medical talents that meet the needs of society.

This study has some limitations. It used stratified random sampling. Therefore, our data may be subject to selection bias. In addition, a specific area of China was studied, a fact which makes it unwarranted to generalize the findings to other medical students from China. However, the results of the study can also give a brief view of the current cultivation of medical students in medical universities in China. Further studies using larger and more diversified sample sizes are needed to validate our results.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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