Analysis of College Student's Health and Common Diseases Based on Differences in Outpatient Medication

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Abstract. This study aimed to analyze the physical health and common diseases of college students through medication in the outpatient department of the Chenggong Campus of Yunnan Normal University, and support the hospital to better serve both students and teachers. The prescriptions were counted based on the defined daily dose analysis in 2021 using the prescriptions from the pharmacy and the computerized management system of the pharmacy in the outpatient department of the Chenggong Campus of Yunnan Normal University. Prescriptions were highest in March and September, thus more in the second half than in the first half of the semester, and significantly less in the holidays. The measured values of the annual dose of medicine consumption of the four disparity indices of CV, T, GE, and A were: 1.8613, 0.4247, 0.5058, and 0.4185, respectively, and the Global Differentiation Index was 0.8026. The kernel density curve of annual drug consumption showed the coexistence of primary and secondary peaks, the defined daily dose system curve of actual medication frequency showed "wave-like" characteristics, and the primary peak was sharper than the two others. The monthly medication analysis provides a clearer picture of the health status, common diseases, and consultation rules of college students, thereby indicating that the common diseases of college students are respiratory system diseases and digestive system diseases, and the medication has cyclical characteristics. Thus, this study provides a basis for precise service of college students' health and reasonable arrangement of drug provision.

Keywords: medication · defined daily dose · physical health · common diseases · the annual dose of medicine consumption

1 Introduction

In the context of comprehensive health, various scholars have explored the health of college students from different perspectives [1, 2]. This study takes the outpatient department of the Chenggong Campus of Yunnan Normal University (the main consultation location for school students) as an example to analyze outpatient medication and its variation characteristics in 2021. The analysis of medication can indirectly understand

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the health status, common diseases, and consultation rules of college students, which is conducive to precise services, reasonable arrangement of medication provision, and thus continuous improvement of healthcare services in the outpatient department of our university.

2 Materials and Methods

2.1 Data Sources

Herein, the data were obtained from the pharmacy prescription and computer management system of the outpatient department of the Chinggong Campus. In addition, the prescription data were collected from January 1 to December 31, 2021. Data items included were medicine name, specification, quantity, and the number of prescriptions.

2.2 Methods

2.2.1 Defined Daily Dose

The defined daily dose (DDD) is defined as the average daily dose of a drug used for the primary therapeutic purpose in adults and based on a 24-h cycle and was used as the analysis method of this study. DDD was based on the dose specified in the New Pharmacology (17th edition) and the Chinese Pharmacopoeia, and medicine not included in the Pharmacopoeia was combined with instructions and clinical practice. Moreover, DDD was used as the unit of analysis of drug frequency, and the annual consumption of medicine was divided by the corresponding DDD value to obtain the defined daily dose system (DDDS). Simultaneously, the annual consumption and actual DDDs of medicine are ranked.

2.2.2 Difference Index Analysis

The Coefficient of Variation (CV), Theil index (T), Generalized Entropy (GE), and Atkinson index (A), were used to analyze the various characteristics of total doses of different medicine consumption. However, the basic principles and ideas of these indices are different, and their results may have different trends. Therefore, in this study, the above indices are integrated to form a comprehensive Global Differentiation Index (GDI). The value of this index can simultaneously reflect the information of the above four traditional spatial divergence indices, and the result is stable, which can comprehensively reflect the overall degree of variation in the total dose of different medicine consumption. The four traditional variance indices were calculated as follows [3–5]:

Coefficient of Variation:

$$\mathrm{CV} = \sqrt{\sum_{i=1}^{n}(x_i - \mu)/n/\mu} \tag{1}$$

Theil index:

$$\mathrm{T} = \frac{1}{n}\sum_{i=1}^{n}\frac{x_i}{\mu}\log\frac{x_i}{\mu} \tag{2}$$

Generalized Entropy (C = 0):

$$\mathrm{GE} = \frac{1}{n}\sum_{i=1}^{n}\log(\mu/x_i) \tag{3}$$

Atkinson index:

$$\mathrm{A} = 1 - \left[\frac{1}{n}\sum_{i=1}^{n}\left(\frac{x_i}{\mu}\right)^{1-\varepsilon}\right]^{1/(1-\varepsilon)} \tag{4}$$

where x_i is the total dose of the ith drug consumed, μ is the mean value of the total dose of the medicine consumption, respectively, and n is the number of medicine types, $n = 1, 2, 3,,,,,,101$. Meanwhile, ε is a parameter related to the sensitivity of the variance value and takes a range of values greater than 0. The larger ε is the greater the weight given to the drug with a relatively low total dose consumed. Furthermore, ε is often taken as 0.5 and 2 [5], and the value of ε is taken as 0.5 in the calculation of this study.

Based on the results of the above four traditional variance measurement indices, the GDI of total consumption dose medicine of was constructed, the expression is following:

$$\mathrm{GDI} = \mathrm{f(CV,\ T,\ GE,\ A)} \tag{5}$$

Each of the four indices is assigned a weight of 0.25, further, the GDI can be expressed as Formula (6):

$$\mathrm{GDI} = (CV + T + GE + A) * 0.25 \tag{6}$$

The five indices CV, T, GE, A, and GDI are constants and have no units.

2.2.3 Analysis of the Overall Variation in Drug Consumption Doses Using Kernel Density Curves

The kernel density estimation represents the modern nonparametric statistical methods. In practical problems of medication, statistics may be erroneous if a certain distribution pattern of the data on total doses of medicine consumption (such as Pareto, gamma, or lognormal distribution) is assumed first based on their assumed distribution pattern. In addition, the kernel density estimation does not presuppose the distribution pattern of total doses of medicine consumption and does not require a pioneering definition of the estimation model, however, it tries to obtain the required information from the data on the medicine consumption doses [6]. Moreover, data on total doses of medicine consumption generally have a small number of highly consumed medicine but a large quantitative gradient, which is difficult to match with some established distribution as described above. Therefore, it is appropriate to estimate their overall distribution using a kernel density function. Assuming that the density function of total doses of medicine consumption is $f(x)$ and the kernel density is estimated as $f_n(x)$, the formula for estimating the kernel density at any total doses of medicine consumption x is as follows [6]:

$$f_n(x) = \frac{1}{nh_n}\sum_{i=1}^{n}K\left(\frac{x - x_i}{h_n}\right) \tag{7}$$

where $K\left(\frac{x-x_i}{h_n}\right)$ is the kernel function, n and h_n are the number of samples and the bandwidth, respectively, which is a positive number related to n.

3 Results and Analysis

3.1 Monthly Prescription Dose Analysis

The monthly prescriptions were counted and plotted as a histogram (Fig. 1). Figure 1 shows that there is a clear semester and seasonal pattern of prescriptions in university hospitals. A total of 4,119 followed by 4,098 prescriptions issued in March and September, respectively. These two months account for 13.06% and 12.99% of the year's prescriptions, respectively. Furthermore, March and September are the beginning of each semester when students return to campus after the break during holidays and are prone to discomfort because of environmental changes and some life factors (Fig. 1).

3.2 Analysis of Medication Frequency

The annual consumption of drugs reflects the number of drugs used each year, which in turn allows us to analyze the types of diseases that students commonly suffer from and helps the university hospital to prepare the appropriate medicine in advance. Herein, the top 20 medication in terms of annual consumption was analyzed, and the DDDS values were calculated based on the DDD recommended by the World Health Organization (WHO), as well as the doses specified in the Chinese Pharmacopoeia, combined with the instructions, and so on (Table 1). In addition, the top 20 consumed are primarily proprietary Chinese medicines, which are classified based on the National Drug Catalog for Basic Medical Insurance, Work-related Injury Insurance, and Maternity Insurance, as well as the Chinese Pharmacopoeia (2020 edition), the New Materia Medica Catalogue (17th edition), and so on (Table 1).

The most frequently used medicines in 2021 were orthopedics and traumatology-topical medicine, Yunnan Baiyao cream. The second most frequently used drugs were anti-infective drugs and Amoxicillin capsules. The third most frequently used drugs were metabolic drugs-vitamins and minerals and calcium carbonate D3 tablets (Caltrate).

The top annual consumption of medicine is for internal medicine (phlegm and cough suppressant), of which the most frequently used is Qiangli pipalu, followed by Qingfei Huatan Pill, Compound Glycyrrhiza Oral Solution, and so on. The second highest annual consumption of drugs is for internal medicine (rheumatism), of which the most frequently used is Sanjiu Weitai Granule. The third largest annual consumption of drugs is for internal medicine (antidepressants), of which the most frequently used is Xiaochaihu granule, followed by Fenghan Ganmao Granule, and Fengreganmao Granule.

3.3 Analysis of Outpatient Medication Variation Characteristics

The Coefficient of Variation (CV), Thiel index (T), Generalized Entropy (GE), and Atkinson index (A) were initially used to calculate the variance characteristics of medication in the outpatient department of the Chenggong Campus of Yunnan Normal University

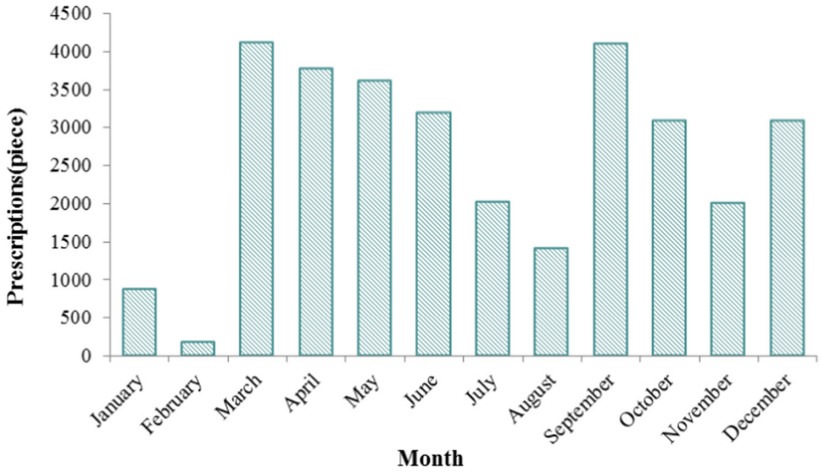

Fig. 1. Monthly prescription dose statistics in 2021

in 2021. After calculation, the measured values of the four disparity indices of CV, T, GE, and A were 1.8613, 0.4247, 0.5058, and 0.4185, respectively. Then, the GDI was calculated based on the expression of the GDI, which was 0.8026 (Table 2).

Subsequently, the kernel density analysis was used to plot the kernel density curves of the annual consumption of drugs and DDDS in Table 1 (Fig. 2 and Fig. 3.) to assess the overall variation in outpatient medication. The coexistence of primary and secondary peaks was shown by the kernel density curves of the annual consumption of drugs, with the primary peak occurring around 3500 (g/tablet/ml/patch) and the secondary peak occurring at 11100 (g/tablet/ml/patch), as compared to the secondary peak, which changed more slowly. Meanwhile, the DDDS curve showed a "wave-like", as compared with the kernel density curve of annual drug consumption, in which the main peak value showed a "spike", and the difference between secondary and main peaks was larger.

The health of college students has been studied from different perspectives with the implementation of the "Health China" strategy [7, 8]. Therefore, in this study, we take the outpatient department of the Chenggong Campus of Yunnan Normal University (the main consultation location for students) as an example to indirectly understand the health status, common diseases, and consultation rules of college students by analyzing the use of outpatient medications in 2021, which is an innovative perspective of this study.

There are semester and seasonal patterns of school students' consultation as shown in the statistical analysis of the monthly prescriptions. The peak of consultation is often at the beginning of each semester, and after the break during holidays, the body will be prone to discomfort because of environmental changes and some life factors. However, this temporal periodicity feature has received little attention in existing studies and is what makes this study valuable and unique.

Table 1. Frequency of medication

Medicine name	Specification	The annual consumption (g/tablet/ml /patch)	DDDs	DDDs ranking	Medicine classification
Qiangli pipalu	150 ml * 1bottle/box	138600	3080	11	Internal medicine-dissipating phlegm, cough and asthma agents
Sanjiu Weitai Granule	20 g * 10 bag/box	133575	3339.375	8	Internal medicine-Qi-regulating agents
Xiaochaihu granule	10 g * 10 bag/box	121500	4050	5	Internal medicine-diaphoretic agents
Shenling Baizhu Granule	10 g * 6 bag/box	110280	3676	7	Internal medicine-strengthening body agent
Banlangen granule	10 g * 6 bag/box	99960	3332	10	Internal medicine-heat-clearing agents
Fenghan Ganmao Granule	8 g * 10 bag/box	80000	3333.333	9	Internal medicine-diaphoretic agents
Antivirus Granule	4 g * 12 bag/box	68508	2537.333	14	Internal medicine -heat-clearing agents
Compound Xianzhuli Liquid	10 ml * 10 piece/box	38000	633.3333	19	Internal medicine-dissipating phlegm, cough and asthma agents
Qingfei Huatan Pill	6 g * 10 bag/box	36540	3045	12	Internal medicine-dissipating phlegm, cough and asthma agents
Lianhua Qingwen Capsule	0.35 g * 24 capsule/box	35028	8340	4	Internal medicine-heat-clearing agents
Fengreganmao Granule	10 g * 10 bag/box	32200	1073.333	17	Internal medicine-diaphoretic agents

(*continued*)

Table 1. (*continued*)

Medicine name	Specification	The annual consumption (g/tablet/ml /patch)	DDDs	DDDs ranking	Medicine classification
Compound Glycyrrhiza Oral Solution	Compound	28560	1190	16	Internal medicine-dissipating phlegm, cough and asthma agents
Herba Leonuri Granule	5 g * 12 bag/box	28440	2844	13	Gynecology medicine-blood rationing medicine
Liuwei Dihuang Pill	9 g * 10 pill/box	28170	1565	15	Internal medicine-strengthening body agent
Watermelon Frost Runhou Tablet	0.6 g * 36 tablet/box	26870	3731.944	6	Internal medicine-heat-clearing prescriptions
Jizhi Syrup	100 ml/bottle	26600	354.6667	20	Internal medicine-dissipating phlegm, cough and asthma agents
Amoxicillin capsule	0.5 g * 16 capsule/box	20040	13360	2	Anti-infective Agents
Calcium Carbonateand D3(Caltrate)	0.6 g* 30 tablet/bottle	19134	7972.5	3	Metabolic drugs-vitamins and minerals
Huoxiang Zhengqi Liquid	10 ml * 8 piece/box	18720	936	18	Internal medicine-dispelling heat agents
Yunnan Baiyao Ointment	10 patch/box	17900	17900	1	Orthopedics and traumatology-topical medicine

Table 2. Variance index measure of the annual consumption of medicine

Variance Index	*CV*	*T*	*GE*	*A*	*GDI*
Measured value	1.8613	0.4247	0.5058	0.4185	0.8026

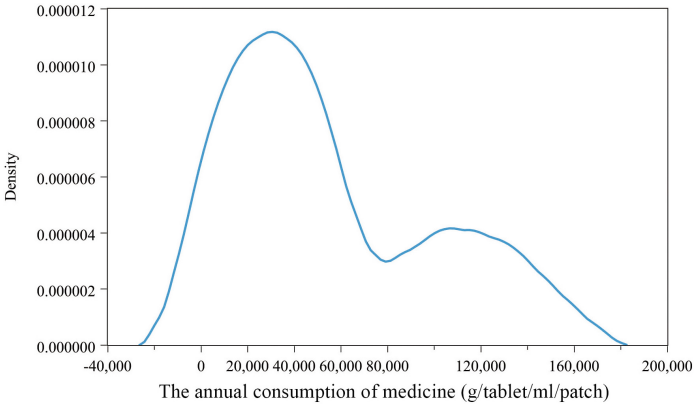

Fig. 2. Kernel density estimation curve for the annual consumption of medicine

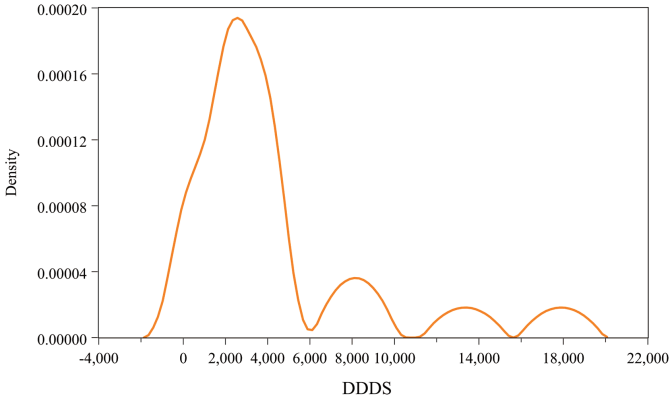

Fig. 3. Kernel density estimation curve of DDDS

4 Discussions

The health of college students has been studied from different perspectives with the implementation of the "Health China" strategy [7, 8]. In this study, we take the outpatient department of the Chenggong Campus of Yunnan Normal University (the main consultation location for students) as an example to indirectly understand the health status, common diseases, and consultation rules of students by analyzing the use of outpatient medications in 2021, which is an innovative perspective of this study.

There are semester and seasonal patterns of school students' consultation as shown by the statistical analysis of the monthly prescriptions. The peak of consultation is at the beginning of each semester, and after the break during holidays, the body will be prone to discomfort because of environmental changes and some life factors. However, this temporal periodicity feature has received little attention in existing studies and is what makes this study valuable and unique.

Given the findings of this study, university hospitals should strengthen epidemic prevention, control, and improve treatment services for university students in the following aspects. First, in terms of time, the corresponding medicines should be prepared in advance during holidays to comfortably cope with the peak period of medication, particularly at the beginning of the semester. Real-time tracking of drug inventory changes and dynamic management to achieve optimal inventory. In addition, in terms of drug varieties, it is important to have sufficient stocks for particular drug types with high consumption. Drawing on the results in this paper, focus on stocking enough upper respiratory tract infection drugs and digestive system drugs, particularly Amoxicillin capsules, Shenling Baizhu Granule, and so on; and among the topical medicines, stock enough Yunnan Baiyao, and so on.

Second, clinical diagnosis and drug use should be standardized and regulated to ensure safe and rational drug uses and avoid duplicate prescriptions and drug abuse. On the one hand, clinicians should avoid simultaneously prescribing drugs with similar medicinal effects (repeated medicinal effects) or drugs with the same mechanism of action and adverse reactions. The level and precision of disease diagnosis should be strengthened to avoid unreasonable use, over-prescription or drug abuse, and so on. On the other hand, the abuse of antibiotics such as Amoxicillin should be avoided. Based on the "*Control Measure for Clinical Application of Antimicrobial Drugs*" issued by the former Ministry of Health, China in 2012 and the "*Notice on Continued Good Clinical Management of Antibacterial Drug Application*" issued by the National Health Commission of the People's Republic of China in 2020, the university hospital should strengthen the scientific and standardized clinical application of antibacterial drugs and avoid antibiotic resistance caused by excessive use of antibiotics. In addition, school hospitals should also focus on improving the level of pharmacy professionals and technical services, and increase the participation of pharmacists in the clinical application of drugs.

Third, strengthen the prevention education and treatment resources allocation for high-incidence diseases. For respiratory infections, we should make efforts to strengthen the prevention and propaganda of this disease which has the highest annual consumption of medicine. Moreover, the prevention and propaganda education of respiratory infections should be carried out for both teachers and students through daily health education classes, a WeChat official account, health brochures, a health bulletin, and small health prescriptions, and carry out the campus "bring a mask" initiative. Furthermore, strengthening the allocation of resources for the treatment of respiratory infections, such as actively introducing highly qualified doctors in this field and increasing the equipment for respiratory infections to enhance the level of treatment of these diseases.

5 Conclusions

The consumption of different types of medicine in college outpatient clinics varies widely and has significant differential characteristics. In addition, the results of the measured values of the four divergence indices CV, T, GE, and A and the GDI index, as well as the kernel density curves of the annual consumption of medicine and DDDS, support this conclusion, which further indicates the differences in diseases among college students.

The common diseases among college students are primarily internal diseases, with respiratory and digestive diseases being the most common [9, 10]. Thus, this suggests that the idea of this study to determine the health status and common diseases of college students through outpatient medication is correct and feasible.

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