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Patterns of multimorbidity in community health centres in Shanghai, China: a retrospective, cross-sectional study based on outpatient data from 2014 to 2018

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ABSTRACT

Objective Caring for patients with multimorbidity is an important part of primary care. It has become increasingly relevant that understanding the spectrum of multimorbidity will help general practitioners (GPs) acquire working knowledge and improve management skills. However, there was little research on characteristics of multimorbidity in primary care in China. This study aimed to identify the spectrum of frequency, proportion and ranking of multimorbidity patterns in adult patients seen at community health centres (CHCs) in Shanghai, China.

Design and setting This was an observational, retrospective, cross-sectional study analysis of outpatient data of 244 CHCs in Shanghai, China.

Participants Adult patients with chronic disease who visited Shanghai CHCs during 2014–2018 were selected from Shanghai CHC electronic medical records database using the International Classification of Diseases 10th Revision codes matched to the Second Version of International Classification of Primary Care codes.

Primary and secondary outcome measures A number of adult patients with chronic disease were counted. Then frequency, proportion and rank of disease patterns of multimorbidity were analysed.

Results Analysis of 301 651 158 electronic health records of 5 909 280 adult patients (54.2% females) found the multimorbidity proportion to be 81.2%. The prevalence of multimorbidity increased with age, which climbed from 43.7% among those aged 19–34 to 94.9% among those more than 80 years of age. The proportion of multimorbidity was higher in females (83.2%) than males (79.7%). Vascular and metabolic diseases were the most frequent diseases for patients over 45 years old.

Conclusions Multimorbidity has brought huge challenges to primary care practice in Shanghai. The Shanghai government should strengthen its support for the multitargeted prevention of chronic diseases and the improvement of GPs' management capabilities.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Wide coverage of the vast majority of 5 909 280 Shanghai adults engaged with the primary care system.
⇒ First study to describe patterns of multimorbidity in primary care of a representative city in China using 301 651 158 electronic medical records.
⇒ Understand the spectrum of multimorbidity in the community from the perspective of service utilisation and provide evidence for improving the diagnosis and treatment capabilities of Chinese general practitioners (GP). Use of a list of chronic diseases from International Classification of Diseases 10th Revision codes was matched to the Second Version of International Classification of Primary Care codes to identify the multimorbidity seen by GPs.
⇒ Analyses were mostly descriptive due to the limitation of statistical power.

increases, it has emerged as an important factor threatening public health. As of 2016, 20%–30% of the global population is experiencing the coexistence of multiple diseases, and multimorbidity among people over 65 has reached 66%–90%.[2]

Multimorbidity leads to more functional decline and disability, lower quality of life, but also higher mortality and risk of harmful drug-related events.[3–5] Patients with multimorbidity have higher requirements for continuous, comprehensive and coordinated care,[6] which is an important part of primary settings. It brings a great challenge for general practitioners (GPs). Under the current single-disease diagnosis and treatment model, GPs lack the understanding of multimorbidity.[7 8] Therefore, it is urgent to be informed by data about the status of multimorbidity in primary care practice in order

INTRODUCTION

Multimorbidity is defined as having two or more chronic diseases at the same time in one person.[1] As the elderly population rapidly

to further improve GPs' understanding and management ability of multimorbidity.

WHO had stated the advantage of analysis based on electronic medical records (EMR), including help to insight areas of concern and the provision of health services.[9] Analysis of EMRs was considered, providing more comprehensive information and more accurate diagnoses than self-reported results by patients in the study of multimorbidity.[10]

However, there was little research on the patterns of multimorbidity based on EMRs in China. Only several studies based on administrative data involved relatively small numbers of patients.[11 12] Furthermore, results of studies based on surveys vary due to differences in study population or study settings.[13] Due to the lagging development of medical information in China, even in Shanghai, which is one of the most developed cities in information technology and medical care in China, the informationisation of medical data has only begun to develop rapidly in recent years. The construction and storage of medical data were incomplete in the early stage. In addition, general practice started late in China, the information system platform of community health centres (CHCs) was also delayed accordingly.[14] Since 2010, the Shanghai Municipal Government has gradually attached the importance to medical big data. The database was built and improved by the government information department, the medical and health supervision department and the data technology companies, which makes it possible to acquire and analyse large patient data with multimorbidity.

Hence, this study aimed to identify the patterns of multimorbidity in CHCs in Shanghai through analysing the EMRs of adult patients with chronic disease during 2014–2018. The findings of this study would provide better understanding of the characteristics of multimorbidity in primary care and offer insights for medical service plan and disease prevention for multimorbidity in Shanghai.

METHODS
Study design
This is an observational, retrospective, cross-sectional study of multimorbidity using the outpatient data of all CHCs in Shanghai, China. All data were sourced from the outpatient and emergency system database platform of Shanghai, which covered the clinic data of all level hospitals in Shanghai.

Data source
CHCs performed as primary care institutions in China. With implementation of medical reform since 2010, general practice has been developed rapidly in Shanghai. The total number of permanent residents in Shanghai is 24.8709 million in 2021. More than 200 CHCs have been set up in Shanghai, with annual outpatient visits of over 40 million and patient information of over 100

million. By 2012, the outpatient and emergency information system platform of primary care institutions had been basically set up and functional. The data on this platform of primary care institutions are comprehensive and standardised. They include the personal information and medical records of all patients seen at all CHCs in Shanghai. Meanwhile, the diagnostic codes for diseases for GPs are unified under the International Classification of Diseases 10th Revision (ICD-10).

The data of patients who visited outpatient and emergency department in any CHC were successfully captured by the outpatient system platform of primary care institutions in Shanghai. Then the data were reported to the departments of district health government further, and finally data reported by all districts formed a large database of outpatient and emergency treatment in CHCs in Shanghai. The database is used by government departments and researchers after authorisation.

Study population
To better understand the current status of multimorbidity among patients with chronic diseases and their medical needs, this study selected adult patients with chronic diseases who visited a CHC in Shanghai from 2014 to 2018 as study population. For the integrity and accuracy of the study, first, all the records of the outpatients in CHCs in Shanghai (number of CHCs: 221 in 2014; 268 in 2015; 266 in 2016; 271 in 2017; 284 in 2018) from 1 January 2014 to 31 December 2018 were selected to compose the panel for analysis. A total of 301 651 169 patient visits were totally involved. After removing 8 904 788 incomplete data and 9 180 156 erroneous records (ie, the demographic information is incomplete, the patient's age is too high or too low), there were 283 566 225 records remained. Then we integrated each record to a 'person' by their identification card number in the database, and finally 5 909 280 adult (over 18 years of age) patients were selected. Demographic information including age and gender of these patients was collected to build the data set. (See figure 1 for the flow chart of data collection.)
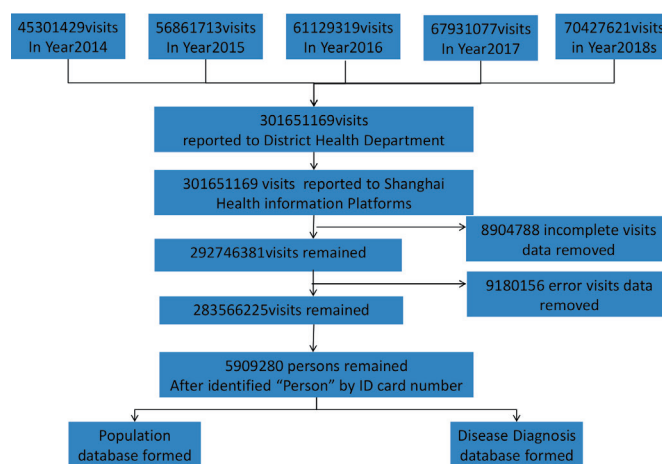
Figure 1 Flow chart of data collection.

Measurement

Due to the lack of consensus on which diseases should be included in the definition of multimorbidity, we included chronic diseases in analysing multimorbidity based on the current literature on multimorbidity by ICD-10 codes.[10 15]

Similar to most previous studies on multimorbidity,[16 17] a patient who has more than two chronic diseases was identified as a multimorbid patient.

To avoid the bias that patients with multiple diseases were counted more than once, each patient was identified by their identification card number in the database and duplicated diagnoses in the database were excluded. Also, ICD-10 codes were matched to the Second Version of International Classification of Primary Care codes proposed by the World Organization of National Colleges, Academies and Academic Associations of General Practice/Family Medicine in order to better identify the diseases and health problems existing in one person[18] (see online supplemental appendix A1).

Statistical analysis

This study analysed the spectrum of the frequency, proportion and ranking of multimorbidity patterns of all adult chronic outpatients from all CHCs in Shanghai in different age groups (19–34, 35–49, 50–64, 65–79, 80+) and both genders (male and female).

Patient and public involvement

No patients or public were involved in the design, outcome measures, recruitment to or conduct of this study. Since the personal information of all patients has been deleted in this study, it is not necessary to disseminate this information to the patients.

RESULTS

Demographics of adult patients from all CHCs between 2014 and 2018 in Shanghai

The demographics of all the extracted outpatients were presented in table 1. There were a total of 5 909 280 adult patients with chronic diseases seen in CHCs during 2014–2018. There were more female patients than male patients (female: n=3 203 222; 54.2%, male: n=2 706 058; 45.8%). Regarding age, the majority of outpatients were in the range of 50–64 (n=2 170 436; 36.7%) and 65–79 (n=1 906 987; 32.3%). The overall ratio of multimorbidity was 81.2% (n=4 822 277). 50.4% of the patients had more than five chronic diseases (n=2 975 664).

Distribution of multimorbidity for adult patients with chronic diseases stratified by gender in all CHCs in Shanghai between 2014 and 2018

As can be seen in figure 2, the proportion of multimorbidity in female patients was a bit higher than that in male patients (male: 79.7%; female: 83.2%). The proportions of patients who had more than five chronic diseases were 45.7% among males and 54.3% among females. Patients with four chronic diseases accounted for 9.0% in males

**Table 1** Demographics of adult patients from all CHCs between 2014 and 2018 in Shanghai

Variables	Group	n	Proportion (%)
Total		5 909 280	100.0
Gender			
	Male	2 706 058	45.8
	Female	3 203 222	54.2
Age			
	19–34	358 019	6.1
	35–49	787 300	13.3
	50–64	2 170 436	36.7
	65–79	1 906 987	32.3
	>80	686 538	11.6
Number of diseases			
	1	1 087 003	18.4
	2	746 679	12.6
	3	599 673	10.2
	4	500 261	8.5
	≥5	2 975 664	50.4

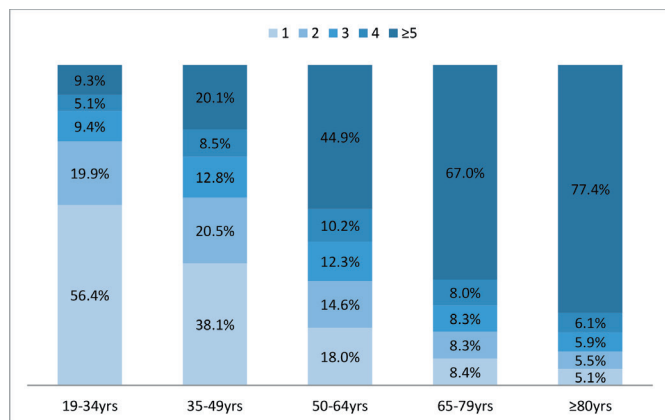CHC, community health centre.

and 8.0% in females. Patients with three chronic diseases accounted for 11.1% in males and 9.4% in females. The proportion of patients with only one chronic disease was 20.3% in males and 16.8% in females.

Distribution of multimorbidity for adult patients with chronic diseases stratified by age in all CHCs in Shanghai between 2014 and 2018

Figure 3 shows the proportion of multimorbidity in terms of age of patients. The trends of multimorbidity went higher with increase in age. The proportion of at least two chronic diseases ranged from 43.7% in patients aged 19–34 years to 94.9% in those aged more than 80 years. The proportion of two diseases in patients aged 19–34,
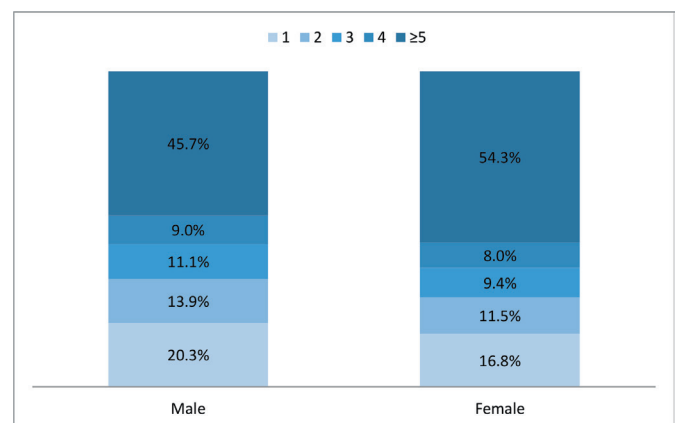
Figure 2 Distribution of multimorbidity for adult patients with chronic diseases stratified by gender in all community health centres (CHCs) in Shanghai between 2014 and 2018.

Figure 3 Distribution of multimorbidity for adult patients with chronic diseases stratified by age in all community health centres (CHCs) in Shanghai between 2014 and 2018.

35–49, 50–64, 65–79 and over 80 years was 19.9%, 20.5%, 14.6%, 8.3% and 5.5%, respectively. The proportion of three diseases in each age group was 9.4%, 12.8%, 12.3%, 8.3% and 5.5%, respectively. However, the proportion of patients without multimorbidity decreased from 56.4% in patients aged 19–34 years to 5.1% in patients over 80 years of age.

Distribution of disease patterns for adult patients with chronic diseases stratified by gender in all CHCs in Shanghai between 2014 and 2018

Table 2 demonstrates the top disease patterns of multimorbidity among total patient population and by gender. Hypertension was found to be the most common chronic disease, either alone or in combination with other diseases. Hypertension and ischaemic heart disease were the most prevalent dyad (0.6% overall, 0.7% in men and 0.5% in women), followed by diabetes and hypertension (0.5% overall, 0.7% in men and 0.4% in women). The most common triad was hyperlipidaemia, hypertension and ischaemic heart disease (0.1% overall, 0.2% in men and 0.1% in women).

Distribution of disease patterns for adult patients with chronic diseases stratified by age in all CHCs in Shanghai between 2014 and 2018

Table 3 demonstrates the top five disease dyads and triads of multimorbidity among five age groups. Among patients aged 19–34 years, teeth/gum disease, stomach function disorder and other skin infection were the most common single diagnoses. Chronic disease and gynaecological disease, and bronchitis/bronchiolitis+stomach function disorder and teeth/gum disease+stomach function disorder are the most frequent dyads.

However, unlike the young group and young people, cardiovascular and metabolic diseases were the most common diseases in patients over the age of 50. Hyperlipidaemia+hypertension+ischaemic heart disease and diabetes+hypertension+ischaemic heart disease were common disease patterns in age groups of 50–64, 65–79 and more

than 80 years old. The disease pattern of hyperlipidaemia+hypertension+ischaemic heart disease accounted for 0.2%, 0.2% and 0.1% of the patients in the groups aged 50–64, 65–79 and over 80 years, respectively.

DISCUSSION

In this study, we identified the disease patterns among patients with chronic disease in CHCs in Shanghai. To the best of our knowledge, it is the first study to describe the spectrum of multimorbidity in primary care setting of China based on data extracted from EMRs, which would provide more comprehensive information on multimorbid patients' needs in Shanghai through comparison between different age and gender groups.

We found that 81% of adult patients with chronic diseases who visited CHCs had multiple chronic conditions, which is higher than that reported in studies in western and other middle-income countries. For instance, a study of primary care for all adult patients in Canada showed nearly half of patients suffered more than two diseases.[19] A Swiss study found a similar prevalence of 52.6%.[20] In Odisha, India, the proportion of multimorbidity was 28.9% among patients attending primary care.[21] The disparity may be due to demographic characteristics among the samples. In this study, adult patients with chronic disease who visited CHCs in Shanghai were selected as the denominator. On the one hand, because general practice in China is still in the development stage, GPs' gatekeeping role has not been fully realised. Thus, patients could choose freely different levels of hospitals in China. Although the number of young people visiting CHCs has been increasing year by year, the overall CHC patient population is still dominated by the elderly. On the other hand, chronic diseases accounted for 91.41% of visits to CHCs between 2014 and 2018 in Shanghai, the proportion of patients with other types of diseases was relatively small.[14] Therefore, the high proportion of multimorbidity in the Shanghai CHCs reflected the characteristics of ageing and chronic diseases of patients in CHCs. It also reminds that the health management department needs to pay attention to the challenges of multimorbidity in primary care.

We also found that the proportion of multimorbidity increased with age. Multimorbidity accounted for 43.7% among the patients aged 18–34 years, 62.9% among the patients aged 35–49 years, but 82.0% among the patients aged over 50 years. The result is similar to a study of 543 patients over age 65 in Ghent, Belgium, which showed a multimorbidity rate as high as 82.6%,[22] and is lower than the reported prevalence of 93.1% in Spain.[23] In addition, it is worth noting that previous studies on multimorbidity have mostly targeted the elderly and evidence for young people was limited. But we have found that multimorbidity was prevalent in young and middle-aged population. It implies that research and prevention strategies for

Table 2 Distribution of disease patterns for total adult patients with chronic diseases in all CHCs in Shanghai between 2014 and 2018

Number of diseases	Rank	Total		Male		Female	
		ICD code	n (%)	ICD code	n (%)	ICD code	n (%)
Single disease	1	I10	229 145 (3.9)	I10	139 287 (5.2)	I10	89 858 (2.8)
	2	K01/K02/K04/K05/K08	113 692 (1.9)	K01/K02/K04/K05/K08	59 182 (2.2)	K01/K02/K04/K05/K08	53 361 (1.7)
	3	K29	46 724 (0.8)	E14	27 281 (1.0)	J40	22 747 (0.7)
	4	J40	45 971 (0.8)	K29	24 137 (0.9)	K29	22 587 (0.7)
	5	E14	43 947 (0.7)	J40	23 224 (0.9)	N76	20 663 (0.7)
	6	M13	39 416 (0.7)	L08	19 886 (0.7)	M13	20 203 (0.6)
	7	I25	34 772 (0.6)	M13	19 213 (0.7)	I25	18 098 (0.6)
	8	L08	31 404 (0.5)	I25	16 674 (0.6)	E14	16 666 (0.5)
	9	L30	31 376 (0.5)	L30	15 649 (0.6)	L30	15 727 (0.5)
	10	H10	25 536 (0.4)	H10	11 824 (0.4)	H10	13 712 (0.4)
Dyads	1	I10+I25	35 505 (0.6)	I10+I25	19 252 (0.7)	I10+I25	16 253 (0.5)
	2	E14+I10	29 882 (0.5)	E14+I10	18 627 (0.7)	E14+I10	11 255 (0.4)
	3	I10+K01/K02/K04/K05/K08	20 918 (0.4)	I10+K01/K02/K04/K05/K08	13 957 (0.5)	I10+K01/K02/K04/K05/K08	6961 (0.2)
	4	I10+J40	14 942 (0.3)	I10+J40	8654 (0.3)	I10+J40	6288 (0.2)
	5	E78+I10	13 623 (0.2)	E78+I10	7897 (0.3)	E78+I10	5726 (0.2)
	6	I10+K29	12 834 (0.2)	I10+K29	7672 (0.3)	I10+K29	5162 (0.2)
	7	I10+I67/I69	10 972 (0.2)	I10+M13	6087 (0.2)	I10+I67/I69	5143 (0.2)
	8	I10+M13	8882 (0.2)	I10+I67/I69	5953 (0.2)	I10+M13	4885 (0.2)
	9	I10+L30	8054 (0.1)	I10+L30	5400 (0.2)	I10+L30	3482 (0.1)
	10	H10+I10	7623 (0.1)	H10+I10	4201 (0.2)	H10+I10	3422 (0.1)
Triads	1	E78+I10+I25	7564 (0.1)	E78+I10+I25	4331 (0.2)	I10+I25+I67/I69	3272 (0.1)
	2	E14+I10+I25	7201 (0.1)	E14+I10+I25	3991 (0.2)	E78+I10+I25	3233 (0.1)
	3	I10+I25+I67/I69	6351 (0.1)	I10+I25+I67/I69	3079 (0.1)	E14+I10+I25	3210 (0.1)
	4	I10+I25+K29	3580 (0.1)	I10+I25+K29	1959 (0.1)	I10+I25+J40	1692 (0.1)
	5	I10+I25+J40	3575 (0.1)	I10+I25+J40	1883 (0.1)	I10+I25+K29	1621 (0.1)
	6	I10+I25+K01/K02/K04/K05/K08	2989 (0.1)	I10+I25+K01/K02/K04/K05/K08	1798 (0.1)	I10+I25+M13	1534 (0.1)
	7	I10+I25+M13	2971 (0.1)	E14+E78+I10	1627 (0.1)	I10+I25+K01/K02/K04/K05/K08	1191 (0.0)
	8	E14+E78+I10	2664 (0.1)	E14+I10+K01/K02/K04/K05/K08	1463 (0.1)	E14+E78+I10	1037 (0.0)
	9	E14+I10+J40	2222 (0.0)	I10+I25+M13	1437 (0.1)	I10+I25+I49	1029 (0.0)
	10	I10+I25+I49	2176 (0.0)	E14+I10+J40	1331 (0.1)	H10+I10+I25	978 (0.0)

CHC, community health centre; ICD, International Classification of Diseases.

multimorbidity should focus on the elderly and recognise its impact in the entire life cycle.[24]

Consistent with other findings, the proportion of multimorbidity in female patients was higher than that in male patients.[25] This may be due to gender differences in medical treatment behaviours. Studies have reported that women may be more likely to use outpatient care services than men; therefore, their chronic diseases may be more likely to be detected than men.[26]

In this study, hypertension was found to be the most common chronic disease, either alone or in combination with other diseases. Hypertension and ischaemic heart disease, diabetes and hypertension, and hypertension and chronic bronchitis were the most important dyads in this study. Hyperlipidaemia, hypertension and ischaemic heart disease were the most common triad in our findings. Cardiovascular diseases and metabolic diseases were the main patterns of multimorbidity in CHCs in Shanghai.

Table 3 Distribution of disease patterns for adult patients with chronic diseases stratified by age in all CHCs in Shanghai between 2014 and 2018

Number of diseases	Rank	19–34 years		35–49 years		50–64 years		65–79 years		More than 80 years	
		ICD code	n (%)	ICD code	n (%)	ICD code	n (%)	ICD code	n (%)	ICD code	n (%)
Single disease	1	K01/K02/K04/K05/K08	27 894 (7.8)	I10	44 432 (5.6)	I10	115 477 (5.3)	I10	51 513 (2.7)	I10	10 778 (1.6)
	2	K29	12 525 (3.5)	K01/K02/K04/K05/K08	33 522 (4.3)	K01/K02/K04/K05/K08	39 660 (1.8)	K01/K02/K04/K05/K08	11 442 (0.6)	I25	3732 (0.5)
	3	L08	10 518 (2.9)	E14	15 003 (1.9)	E14	22 144 (1.0)	I25	9998 (0.5)	M13	1708 (0.3)
	4	J40	10 425 (2.9)	M13	14 504 (1.8)	E14	15 539 (0.7)	E14	9518 (0.5)	E14	1623 (0.2)
	5	N76	9298 (2.6)	I25	10 811 (1.4)	M13	15 266 (0.7)	M13	6769 (0.4)	I67/I69	1328 (0.2)
	6	L30	8474 (2.4)	J40	10 118 (1.3)	J40	14 173 (0.7)	J40	5292 (0.3)	J40	1078 (0.2)
	7	N92	7307 (2.0)	K29	9124 (1.2)	K29	13 943 (0.6)	K29	4812 (0.3)	K59	1014 (0.2)
	8	I10	6945 (1.9)	L30	8310 (1.1)	L30	9203 (0.4)	I67/I69	4064 (0.2)	K29	940 (0.1)
	9	K52	6378 (1.8)	E78	8249 (1.1)	E78	8544 (0.4)	E78	3763 (0.2)	G47	867 (0.1)
	10	M54	5764 (1.6)	H10	7567 (1.0)	H10	8142 (0.4)	L30	3730 (0.2)	L30	845 (0.1)
Dyads	1	N76+N92	910 (0.3)	E14+I10	3138 (0.4)	E14+I10	16 023 (0.7)	I10+I25	12 453 (0.7)	I10+I25	4268 (0.6)
	2	J40+K29	604 (0.2)	I10+I25	2955 (0.4)	I10+I25	15 797 (0.7)	E14+I10	8770 (0.5)	E14+I10	1647 (0.2)
	3	K01/K02/K04/K05/K08+K29	521 (0.2)	I10+J40	2711 (0.3)	I10+K01/K02/K04/K05/K08	12 238 (0.6)	I10+K01/K02/K04/K05/K08	5116 (0.3)	I10+I67/I69	1204 (0.2)
	4	J40+K01/K02/K04/K05/K08	491 (0.1)	I10+K01/K02/K04/K05/K08	2139 (0.3)	I10+J40	7701 (0.4)	I10+J40	3933 (0.2)	I10+J40	847 (0.1)
	5	L08+L30	486 (0.1)	I10+K29	2002 (0.3)	E78+I10	7203 (0.3)	E78+I10	3626 (0.2)	I10+M13	846 (0.1)
	6	K29+K52	477 (0.1)	E78+I10	1961 (0.3)	I10+K29	6665 (0.3)	I10+I67/I69	3535 (0.2)	I10+K59	693 (0.1)
	7	J40+L30	372 (0.1)	I10+M13	1226 (0.2)	I10+M13	5389 (0.3)	I10+M13	3319 (0.2)	I10+K29	675 (0.1)
	8	K29+L30	366 (0.1)	I10+L30	1220 (0.2)	I10+L30	4630 (0.2)	I10+K29	3142 (0.2)	E78+I10	580 (0.1)
	9	I10+K29	350 (0.1)	J40+K29	1103 (0.1)	I10+I67/I69	4010 (0.2)	I10+L30	2335 (0.1)	I25+I67/I69	561 (0.1)
	10	I10+J40	322 (0.1)	N76+N92	1047 (0.1)	H10+I10	3773 (0.2)	H10+I10	2278 (0.1)	I10+L30	527 (0.1)

Continued

Table 3 Continued

Number of diseases	Rank	19–34 years ICD code	n (%)	35–49 years ICD code	n (%)	50–64 years ICD code	n (%)	65–79 years ICD code	n (%)	More than 80 years ICD code	n (%)
Triads	1	J40+K01/K02/K04/K05/K08+K29	71 (0.0)	E78+I10+I25	460 (0.1)	E78+I10+I25	3460 (0.2)	E78+I10+I25	2880 (0.2)	I10+I25+I67/I69	1184 (0.2)
	2	K01/K02/K04/K05/K08+K29+K52	50 (0.0)	E14+E78+I10	266 (0.0)	E14+I10+I25	3257 (0.2)	E14+I10+I25	2767 (0.2)	E14+I10+I25	839 (0.1)
	3	J40+K29+K52	50 (0.0)	E14+I10+I25	248 (0.0)	I10+I25+I67/I69	2349 (0.1)	I10+I25+I67/I69	2561 (0.1)	E78+I10+I25	721 (0.1)
	4	N76+N91+N92	47 (0.0)	I10+I25+J40	235 (0.0)	I10+I25+K29	1675 (0.1)	I10+I25+J40	1313 (0.1)	I10+I25+M13	498 (0.1)
	5	I10+J40+K29	46 (0.0)	I10+J40+K29	233 (0.0)	I10+I25+J40	1538 (0.1)	I10+I25+K29	1305 (0.1)	I10+I25+J40	463 (0.1)
	6	K01/K02/K04/K05/K08+K29+L30	43 (0.0)	I10+I25+K29	229 (0.0)	I10+I25+K01/K02/K04/K05/K08	1472 (0.1)	I10+I25+M13	1203 (0.1)	I10+I25+K59	397 (0.1)
	7	E78+I10+I25	43 (0.0)	I10+J40+K01/K02/K04/K05/K08	226 (0.0)	E14+E78+I10	1435 (0.1)	I10+I25+K01/K02/K04/K05/K08	1135 (0.1)	I10+I25+K29	348 (0.1)
	8	J40+K29+L30	42 (0.0)	E14+I10+K01/K02/K04/K05/K08	187 (0.0)	E14+I10+K01/K02/K04/K05/K08	1275 (0.1)	I10+I25+I49	830 (0.0)	I10+I25+I49	334 (0.1)
	9	K29+N76+N92	38 (0.0)	I10+I25+I67/I69	185 (0.0)	E14+I10+J40	1207 (0.1)	E14+E78+I10	813 (0.0)	G47+I10+I25	311 (0.1)
	10	K01/K02/K04/K05/K08+N76+N92	38 (0.0)	I10+K01/K02/K04/K05/K08+K29	164 (0.0)	I10+I25+L30	1122 (0.1)	I10+I25+L30	778 (0.0)	I10+I25+L30	297 (0.0)

CHC, community health centre; ICD, International Classification of Diseases.

These results are consistent with the relevant literature across the world. For example, a survey conducted in Nanjing, Jiangsu Province, showed that hypertension, diabetes, coronary heart disease and other diseases were common coexisting diseases among urban residents.[27] A study of 1480 adults aged more than 60 years in rural China also showed the same disease pairs.[28] Studies in developed countries such as the USA[29] and the UK[30] also show that metabolic diseases and cardiovascular and cerebrovascular diseases were common disease combinations. These results may be related to economic development and changes in people's lifestyles. At the same time, it is also related to the Chinese government's policy emphasis on the prevention and treatment of chronic diseases. Hypertension and diabetes are currently important contents of chronic disease management in the community. Our findings also provide evidence for the need of multitargeted prevention and management strategies for chronic diseases.

However, we also found that the most prominent combination of arthritis or rheumatism and other diseases in the survey of Chinese community residents is relatively low in CHCs.[31] Compared with primary care in developed countries, mental illness, tumours, tobacco and alcohol dependencies are very rare in CHCs in China.[6] This finding hints at the limitations of Chinese GPs' scope disease treatment. Most of these diseases are treated in large general hospitals, which highlights the need to strengthen the diagnosis and treatment capabilities of Chinese GPs.

Our research also found that among young patients aged 19–34, gynaecological diseases and oral diseases are the main types of diseases. For example, vaginitis and irregular menstruation rank first in the combination of diseases, followed by dental diseases such as pulpitis, periodontal disease and dental caries. Studies have reported that dental disease is a risk factor for many chronic diseases.[32 33] GPs need to pay attention to the challenge of oral diseases.

There are also some limitations in our study. First, our study is based on the retrospective review of EMRs. Therefore, as other studies conducted with EMRs,[34] only the diagnoses recorded in CHCs were included, excluding health problems seen elsewhere, which likely underestimated the scope multimorbidity. Second, due to the limitation of statistical power, analyses were mostly descriptive and no control group was included. Socioeconomic data like family income cannot be obtained from EMRs, and thus we could not compare the differences in socioeconomic groups in this study.

CONCLUSIONS

Multimorbidity is an unexplored but urgent need to understand in primary care in China. This study provides information on the patterns of multimorbidity among the patients in CHCs in Shanghai. The proportion of multimorbidity in adult patients with chronic diseases visiting CHCs is as high as 81.1%, and it increases with age. Distribution of multimorbidity is higher in female patients than that in male patients. Vascular and metabolic diseases are most frequent patterns in patients over 45 years old, but among the young patients, gynaecological diseases and oral diseases are the main disease combinations. Multimorbidity has brought huge challenges and burdens to GPs in primary care practice in Shanghai. China should strengthen its support for the prevention of chronic diseases and the improvement of GPs' chronic disease management capabilities.

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