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Prevalence and patterns of multimorbidity in chronic diseases in Guangzhou, China: a data mining study in the residents' health records system among 31,708 community-dwelling elderly people

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1   **Prevalence and patterns of multimorbidity in chronic diseases in Guangzhou,**

2   **China: a data mining study in the residents' health records system among 31,708**

3   **community-dwelling elderly people**

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2

27 **Abstract**

28 **Background** Through data mining of residents' health records in community health

29 service centers, we estimated the prevalence of chronic diseases, multimorbidity and

30 patterns of multimorbidity in Guangzhou, China.

31 **Methods** A multistage, stratified random sampling was adopted for selection of health

32 records in the residents' health records system of Guangzhou. Data on age, gender,

33 marital status, educational level, living areas, medical insurance, and the past medical

34 history were collected in residents' health records in this study. Data mining by

35 association rule mining analysis was used to explore the correlations and

36 multimorbidity patterns between seven chronic diseases.

37 **Results** The prevalence of morbidity was 54.99% (95%CI: 40.11%-60.11%) and the

38 multimorbidity was 15.17% (95%CI: 12.38%-18.44%) among 31,708

39 community-dwelling elderly people in Guangzhou, China. Elderly, female, higher

40 education level, being single, living in urban areas and having medical insurance were

41 more likely to have chronic diseases and multimorbidity. Our data included seven

42 prevalent chronic conditions, most of which accompanied with one or more other

43 chronic diseases. Our study also reveals several patterns of multimorbidity among

44 elderly residents in Guangzhou, including coexistence of hypertension and diabetes,

45 hypertension and coronary heart disease, diabetes and coronary heart disease, diabetes,

46 coronary heart disease and hypertension.

47 **Conclusions** A high prevalence of morbidity and a relatively low multimorbidity of

48 chronic diseases exist in elderly people. Data mining of residents' health records will

49 help for strengthening the management of residents' health records in community

50 health service centers of Guangzhou, China.

51 *Keywords:* Chronic diseases; Patterns of multimorbidity; Data Mining; Elderly people

52

53

54 **Strengths and limitations of this study**

55 1. Data mining study of electronic health records in community health service centers

56   are limited in China.

57   2. The prevalence of morbidity, multimorbidity, and patterns of multimorbidity

58   were reported among residents' health records in community health service

59   centers of Guangzhou.

60 3. Although the sample size was enough, the number of chronic diseases were small

61   in this study.

62 4. The residents' health records in communities were based on self-reporting; thus, the

63   selection bias and recall bias were introduced.

64 5. A larger and prospective cohort design based on residents' health records to infer

65   the causal relationship is needed in future research.

4

67 **Introduction**

68 China is experiencing a rapidly growing aging population. Data from seventh national

69 census of National Bureau of Statistic in China showed that individuals aged 65 years

70 or older constitute about 13.5% (191 million) of the total population in 2020.[1] With

71 the population aging, chronic diseases have become an important public health

72 challenge in China. It is estimated that, by 2030, 12.2 million people will die of

73 chronic diseases in China and the mortality rate of chronic diseases would increase up

74 to 40.0% (859.2 *vs* 613.5/100, 000) compared to 2013.[2] What makes the situation

75 worse is multimorbidity, which is defined as the co-existence of two or more chronic

76 diseases in one person,[3] has increasingly gained attention in recent decades.

77 Multimorbidity is associated with poor health outcomes, such as reduced function

78 levels, increased psychological distress,[4, 5] impaired quality of life,[6, 7] and increased

79 rates of disability and mortality.[8, 9] Multimorbidity is also associated with increase the

80 healthcare expenditures among elderly people. [10] It was reported that 72.7% of

81 outpatient services and 77.3% of inpatient services were used by patients with

82 multimorbidity.[11] Another study in Beijing China reported that the expenditure on

83 elderly people with two and three conditions was 3.4 times and 5.3 times higher than

84 that on elderly people with a single condition.[12]

85 Although reported previously,[13, 14] the prevalence and pattern of multimorbidity

86 among elderly people varied significantly. The overall prevalence of multimorbidity

87 ranged from 6.4% to 76.5% in the elderly people in China,[15, 16] even, 90.5% among

88 older Chinese adults living in rural areas.[17] The wide variations in prevalence of

89 multimorbidity in those studies may be related to differences of the included diseases,

5

90 the assessment methods and instruments, differences in environment and lifestyles,

91 and so on. For example, a systematic review study in South Asia found that

92 prevalence of multimorbidity ranged from 4.5% to 83%, and the included number of

93 diseases in a given study varied from 7 to 22.[18] Meanwhile, the various patterns of

94 multimorbidity were reported in different studies, which used different statistical

95 methods, such as factor analysis, cluster analysis, and association rule mining analysis.

96 The common multimorbidity patterns included pattern of osteoarthritis and

97 rheumatoid arthritis with hypertension,[19] pattern of hypertension and diabetes,[6] pattern

98 of cardiopulmonary mental degenerative disorder, pattern of cerebrovascular

99 metabolic disorder,[17] and so on. Nonetheless, it is indisputable that multimorbidity is

100 prevalent among elderly people in China.

101   The project of health records of residents in community health service centers, one

102 of the national basic public health service projects, has been implemented in China.

103 As part of the national project, the city of Guangzhou established an electronic health

104 record system since 2009. To 2020, 91.23% residents of Guangzhou have established

105 health records in their community health service centers in different districts. Data

106 mining of electronic health records thus becomes a novel way to understand disease

107 morbidity and multimorbidity among residents. However, studies with application of

108 electronic health records in community health service centers are limited in China.

109   By taking advantage of the abundant data, we therefore set out a data mining study

110 in the electronic health record of residents in community health service centers of

111 Guangzhou. We aim to assess prevalence and influence factors of chronic diseases

6

112   and   multimorbidity   and   to   explore   patterns   of   multimorbidity   among

113   community-dwelling elderly people in Guangzhou, China.

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Methods

115

Study design and Data Source

116

117   From October to December 2020, a multistage, stratified random sampling was

118   adopted for selection of residents' health records in Guangzhou. Firstly, based on the

119   population per district, we selected 2, 4, or 6 community health service centers in each

120   district (**Figure 1**). Secondly, in each selected community health service center, we

121   further   selected   2   sub-district   community   health   service   centers,   and   all

122   community-dwelling residents' health records were adopted. Finally, among them,

123   31,708 health records were derived from residents aged 65 years or above. The

124   sampling framework was showed in detail in **Figure 1**.

125   *Patient and public involvement*

126   Patients or public were not involved in this study.

127   *Instruments*

128   **Socio-demographic Characteristics**

129   The socio-demographic information, including age, gender, marital status,

130   educational level, living area, and medical insurance were selected in residents' health

131   records in the present study.

132   **Morbidity coding**

133   All the 7 chronic conditions were reported in the past medical history in residents'

7

134   health records, which were selected in the present study as following, Hypertension,

135   Diabetes, Coronary heart disease, Apoplexy, COPD, Tumor and Mental disorder.

136   International Classification of Diseases (ICD-10) codes was used for all diagnoses.

137   For this study, multimorbidity was defined as the co-existence of two or more chronic

138   conditions in one person.[3]

139   *Data analyses*

140   Statistical analysis was performed using R and SPSS 21.0 (SPSS Inc., Chicago, IL).

141   The Chi-square, t-test and one-way analysis of variance (ANOVA), were used to

142   assess the differences in socio-demographic characteristics between subjects. Binary

143   logistic regression analysis was conducted to examine factors associated with chronic

144   diseases and multimorbidity, and a forward stepwise selection strategy was adopted

145   when the regression models performed. To increase the representativeness of the

146   study population, all statistics were calculated by using base weights adjustment

147   (population weight and post-stratification sample weights). The complex samples

148   module in SPSS 21.0 was adopted to account for the multistage sample design.

149   Geographic heat map of chronic diseases were draw by R 3.2.1 program. The

150   association rule mining analysis was used to explore the correlations and patterns of

151   multimorbidity between chronic diseases among community-dwelling elderly people.

152    $P < 0.05$ was considered statistically significant in the present study.

153

154   **Results**

155   Seven chronic conditions in the residents' health records system among 31,708

8

156 community-dwelling elderly people exist in Guangzhou (**Table 1**). The prevalence of

157 morbidity was 54.99% (95%CI: 40.11%-60.11%) and the most common chronic

158 disease was hypertension (47.76%, 95%CI: 44.54%-50.99%). Prevalence of Other

159 selected chronic conditions was also reported, including 15.94% (95%CI:

160 14.38%-17.64%) for diabetes, 4.90% (95%CI: 3.02%-7.84%) for coronary heart

161 disease, 1.33% (95%CI: 0.84%-2.09%) for apoplexy, 0.71% (95%CI: 0.37%-1.37%)

162 for COPD, 1.27% (95%CI: 0.82%-1.98%) for tumor and 0.48% (95%CI:

163 0.32%-0.71%) for mental disorder.

164 The prevalence of chronic conditions in community-dwelling elderly people

165 showed regional differences in Guangzhou China (**Figure 2**). According to the heat

166 map of prevalence by region, elderly people living in urban areas were more likely to

167 have chronic conditions. The risk of morbidity and multimorbidity in elderly people

168 was growing up as people get older (**Figure 3**). Half of the people aged 65-69 had at

169 least one disorder and the number gradually increased with age.

170 Of the 31,708 respondents, 15.17% (95%CI: 12.38%-18.44%) of elderly people had

171 multimorbidity (**Table 1**). Results of regression analysis (**Table 2**) showed that

172 factors associated with morbidity and multimorbidity. Elderly, female, higher

173 education level, being single, living in urban areas and having medical insurance were

174 more likely to have chronic diseases and multimorbidity.

175 Results of data mining study by association rule mining analysis showed that seven

176 selected chronic conditions, most of them accompanied with one or more other

177 chronic diseases. **Figure 4** showed that 66.35% of elderly people with hypertension

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178   had only one condition (hypertension), while 33.65% experienced one or more

179   additional chronic diseases (multimorbidity). On the contrary, 85.66% of elderly

180   people with apoplexy reported experiencing one or more additional chronic diseases

181   (multimorbidity), only 14.34% of those had apoplexy alone. Moreover, web diagram

182   analysis revealed that these chronic diseases were highly related to each other (**Figure**

183   **5**).

184   **Table 3** showed the patterns of multimorbidity in the present study, and the most

185   common pattern of multimorbidity was model of hypertension and diabetes.

186   Meanwhile, model of hypertension and coronary heart disease, model of diabetes and

187   coronary heart disease, model of diabetes, coronary heart disease and hypertension

188   were also reported.

189

190   **Discussion**

191   **Main Findings**

192   In this study, we found that the prevalence were 54.99% for morbidity and 15.17% for

193   multimorbidity, and which were associated with several factors among 31,708

194   community-dwelling elderly people. Data mining of association rule mining analysis

195   can explore the correlations and patterns of multimorbidity between chronic diseases,

196   which will help for strengthening the management of residents' health records in

197   community health service centers of Guangzhou, China.

198   **Comparison with Previous Studies**

10

199 Chronic diseases are becoming more and more common and their prevalence is

200 rapidly increasing.[20] In the present study, the prevalence of morbidity was 54.99%

201 among elderly people in Guangzhou, China, which was similar to previous studies. [14]

202 47.76%, 15.94%, 4.90% of elderly people with hypertension, diabetes, coronary heart

203 disease, respectively, which was consistent with previous studies. [13, 14, 21, 22] In the

204 present study, we found that the prevalence of multimorbidity was 15.17% among

205 31,708 community-dwelling elderly people in Guangzhou, China, which is consistent

206 with previous reports from Li and colleagues (16.1% among the elderly adults aged

207 ≥60 years in southwest China), and Bao and colleagues (20.8% of middle-aged and

208 elderly residents in southern China).[6] However, Zhang and colleagues found that

209 multimorbidity was 43.6% of elderly people in a nationally representative sample of

210 China,[13] and Yao and colleagues found that multimorbidity occurred in 42.4% of the

211 participants from the China Health and Retirement Longitudinal Study.[23] Moreover,

212 Wang and colleagues found that multimorbidity prevalence was 81.3% among one

213 million older group in China, even, 90.5% among older adults living in rural areas of

214 China.[17] Compare with those studies, the wide variations in prevalence of

215 multimorbidity may due to differences of the included chronic diseases and the

216 assessment method and instrument. In the present study, only seven chronic

217 conditions were included. And the assessment method and instrument were based on

218 residents' health records in community health service centers of Guangzhou, the

219 imperfection of residents' health records may also contribute to low prevalence.

220   Nevertheless, chronic diseases and multimorbidity should not be overlooked among

221   community-dwelling elderly people.

222   We found that age was associated with multimorbidity. With aging the prevalence

223   of multimorbidity was higher. [24, 25] With aging and immunity declining, risk of

224   illnesses will increase naturally among elderly people. Study of China Kadoorie

225   Biobank was found that a higher increase in the number of chronic conditions was

226   found in the older people.[26] The prevalence of multimorbidity was higher among

227   women[24] and living in urban areas,[22, 26] which was consisted with previous studies.[23]

228   Elderly people in rural areas may have limited medical resources than urban residents,

229   which might lead to a lower probability of being diagnosed. Interestingly, higher

230   education level and having medical insurance were also found to be associated with

231   higher prevalence of multimorbidity.[25] People of higher education level generally had

232   higher health literacy level and had more healthcare-seeking behaviors; meanwhile,

233   regular physical examinations in elderly people who had medical insurance also

234   helped them of being diagnosed. Compare with married status, elderly people being

235   single (unmarried, divorced or widowed) was positively associated with

236   multimorbidity.[27] One alternative explanation might be that loneliness may result in a

237   higher risk of multimorbidity.[28]

238   Cluster analysis and association rule mining analysis are the common data mining

239   methods to calculating the associations between different diseases. Different from

240   cluster analysis, association rule mining analysis can directly calculate the probability

241   of multimorbidity, when participants had a chronic disease. Therefore, association

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242   rule mining analysis was adopted for analyzing patterns of multimorbidity in the

243   present study, and the most common pattern of multimorbidity was reported: model of

244   hypertension and diabetes. Specifically, when the elderly people have diabetes,

245   17.58% of them are more likely to have hypertension (**Table 3**). Similar result was

246   reported in a prospective cohort study, prevalent of multimorbidity of

247   diabetes-hypertension was 12.5%.[29] Blümel and colleagues found that hypertension

248   coexisted in 22.0% of women with diabetes.[30] Prathapan and colleagues found that a

249   fourth of the sample were affected by multimorbidity of diabetes and hypertension,

250   and the combinations of coronary heart disease with hypertension and diabetes were

251   also significantly prevalent.[31] Bao and colleagues demonstrated that the most

252   prevalent chronic diseases pair was hypertension and diabetes among community

253   middle-aged and elderly residents in southern China.[6] Meanwhile, in the present study,

254   model of hypertension and coronary heart disease, model of diabetes and coronary

255   heart disease, model of diabetes, coronary heart disease and hypertension were also

256   reported. A nationally representative sample of middle-aged and older adults study

257   showed that three top prevalent multimorbidity combinations were,

258   diabetes-arthritis-hypertension; diabetes-hypertension; and

259   diabetes-arthritis-hypertension-heart disease.[29] Other study of community-dwelling

260   elderly people in Nanjing, China, found that hypertension and diabetes, hypertension

261   and coronary heart disease, hypertension and dyslipidemia, diabetes and cataract,

262   diabetes and hearing disorder, hypertension and stroke were the common patterns of

263   multimorbidity.[16] Exploring patterns of multimorbidity may contribute to implement

13

264   the effective prevention, interventions, treatment measures and management strategies

265   of multimorbidity, and more attention are required for researchers.

266   Some limitations were included in this study. Firstly, although the sample size was

267   enough, the number of chronic diseases were small in this study. Secondly, the

268   prevalence of major chronic diseases was consisted with results of the national health

269   survey, but some chronic diseases were lower than other studies, such as apoplexy,

270   COPD, and tumor. Those may lead to a low prevalence of multimorbidity. At the

271   same time, the residents' health records in communities were based on self-reporting;

272   thus, the selection bias and recall bias were introduced. Therefore, a larger and

273   prospective cohort design based on residents' health records to infer the causal

274   relationship is needed in future research.

275   Some strengths were also included in present study. There are few studies on data

276   mining of residents' health records in community health service centers in China. In

277   the present study, a multistage, stratified random sampling method was selected, and

278   31,708 elderly people were adopted, which can explore representatively the current

279   status and quality of residents' health records of Guangzhou, southern of China. And

280   the results will help for strengthening the management of residents' health records in

281   community health service centers of Guangzhou, China.

282   **Conclusions**

283   Our study indicated that a high prevalence of morbidity and a relatively low

284   multimorbidity of chronic diseases among 31,708 community-dwelling elderly people

285   in Guangzhou, China. Elderly, female, higher education level, being single, living in

14

urban areas and having medical insurance were more likely to have chronic diseases and multimorbidity. Data mining of residents' health records in community health service centers by association rule mining analysis showed that pattern of multimorbidity were model of hypertension and diabetes, model of hypertension and coronary heart disease, model of diabetes and coronary heart disease, model of diabetes, coronary heart disease and hypertension.

Acknowledgments

Contributions

WQL, CW, YHL, LL, YOY, DW, and GZL supervised the study data collection and quality control. WQL, HL and GZL conducted the literature review. WQL and EML conducted the data analyses. WQL, LXY and MYS drafted the manuscript, WQL and HL finalized the manuscript with inputs from all authors.

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Competing interests

None declared.

15

308 **Patient consent for publication**

309 Not required.

310 **Ethics approval**

311 Ethical approval for this survey was obtained from the Ethics Committee of Center for

312 Disease Control and Prevention of Guangzhou (GZCDC-ECHR-2020P0004).

313 **Provenance and peer review**

314 Not commissioned; externally peer reviewed.

315 **Data availability statement**

316 No additional data are available.

317

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Figure Legend

Figure 1: Sampling framework in this study in Guangzhou, China

Note: CHCs: Community health centers.

Figure 2: Prevalence of chronic conditions by region in community-dwelling elderly people in Guangzhou, China

Note: [a] Prevalence of Hypertension.
  [b] Prevalence of Diabetes.
  [c] Prevalence of Coronary heart disease.
  [d] Prevalence of Apoplexy.
  [e] Prevalence of Morbidity.
  [f] Prevalence of Multimorbidity.

Figure 3: Number of chronic conditions by age group in community-dwelling elderly people in Guangzhou, China

Figure 4. Number of chronic conditions in community-dwelling elderly people in Guangzhou, China

Figure 5. Web diagram of comorbidity in community-dwelling elderly people in Guangzhou, China

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Table 1. Socio-demographic and comorbidity characteristics in community-dwelling elderly people in Guangzhou, China

Variables	Total		Prevalence of hypertension (95% CI)[a]	P^b	Prevalence of diabetes (95% CI)[a]	P^b	Prevalence of coronary heart disease (95% CI)[a]	P^b	Prevalence of apoplexy (95% CI)[a]	P^b
	n	%								
All participants	31708	100.00	47.76 (44.54-50.99)		15.94 (14.38-17.64)		4.90 (3.02-7.84)		1.33 (0.84-2.09)	
Age groups, years				0.001		0.001		0.001		0.001
65-74	19853	62.61	42.34 (39.32-45.43)		14.99 (13.82-16.25)		3.98 (2.48-6.32)		1.15 (0.78-1.70)	
75-84	9023	28.46	55.29 (50.96-59.53)		17.93 (15.56-20.57)		6.26 (3.88-9.94)		1.53 (0.88-2.65)	
≥85	2832	8.93	59.91 (54.35-65.23)		15.37 (11.71-19.91)		6.65 (3.63-11.86)		1.88 (0.99-3.54)	
Gender				0.001		0.001		0.001		0.001
Male	14046	44.30	45.33 (42.09-48.61)		14.32 (12.78-16.01)		4.66 (2.97-7.24)		1.51 (0.96-2.36)	
Female	17662	55.70	49.85 (46.56-53.14)		17.33 (15.66-19.15)		5.10 (3.06-8.39)		1.17 (0.73-1.88)	
Education levels				0.001		0.001		0.001		0.001
No school	3372	10.63	51.63 (45.22-57.98)		15.73 (12.59-19.48)		2.31 (1.27-4.18)		1.12 (0.47-2.67)	
Primary school	11258	35.51	49.98 (45.94-54.01)		16.19 (14.12-18.49)		4.31 (2.70-6.79)		1.58 (0.92-2.70)	
Secondary school	12668	39.95	43.90 (40.32-47.55)		15.56 (14.34-16.87)		5.82 (3.47-9.63)		1.14 (0.76-1.71)	
College and above	4410	13.91	50.22 (45.26-55.17)		17.42 (14.67-20.56)		8.56 (6.36-11.42)		1.61 (1.05-2.47)	
Marital status				0.001		0.020		0.004		0.001
Single [d]	3685	11.62	50.88 (44.98-56.75)		16.18 (14.23-18.33)		5.07 (2.87-8.80)		2.00 (1.04-3.81)	
Married	28023	88.38	47.34 (44.34-50.36)		15.91 (14.29-17.68)		4.87 (3.03-7.74)		1.24 (0.81-1.89)	
Living Areas				0.001		0.001		0.001		0.001
Rural areas	6447	20.33	41.71 (35.60-48.09)		12.47 (10.54-14.70)		1.63 (0.89-2.94)		0.82 (0.43-1.56)	
Urban areas	25261	79.67	50.38 (47.03-53.74)		17.45 (16.24-18.73)		6.32 (4.04-9.75)		1.55 (1.00-2.39)	
Medical insurance				0.001		0.001		0.001		0.001
Uninsured	1126	3.55	42.37 (36.63-48.32)		16.95 (13.55-20.98)		3.52 (2.48-4.99)		1.79 (1.13-2.82)	
Insured	30582	96.45	47.90 (44.58-51.23)		15.92 (14.32-17.65)		4.93 (3.01-7.97)		1.32 (0.83-2.09)	

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Table 1. Socio-demographic and comorbidity characteristics in community-dwelling elderly people in Guangzhou, China *(Continued)*

Variables	Mean of morbidities M± SD	P^c	Prevalence of morbidity (≥ 1 chronic diseases, 95% CI) [a]	P^b	Prevalence of multimorbidity (≥ 2 chronic diseases, 95% CI) [a]	P^b
All participants	0.72±0.77		54.99 (40.11-60.11)		15.17 (12.38-18.44)	
Age groups, years		0.001		0.001		0.001
65-74	0.65±0.74		50.21 (46.95-53.47)		12.87 (10.82-15.23)	
75-84	0.84±0.80		61.77 (56.43-66.84)		18.99 (15.30-23.33)	
≥85	0.87±0.79		65.14 (59.15-70.68)		17.81 (11.56-26.42)	
Gender		0.001		0.001		0.001
Male	0.69±0.76		52.72 (48.94-56.46)		14.06 (11.40-17.22)	
Female	0.75±0.78		56.94 (53.28-60.54)		16.11 (13.19-19.53)	
Education levels		0.001		0.001		0.001
No school	0.72±0.72		57.98 (50.43-65.18)		12.91 (9.51-17.30)	
Primary school	0.74±0.77		57.09 (53.32-60.77)		14.92 (11.70-18.84)	
Secondary school	0.69±0.79		51.37 (47.05-55.68)		15.59 (12.85-18.78)	
College and above	0.81±0.82		58.70 (52.97-64.20)		19.27 (15.65-23.49)	
Marital status		0.001		0.001		0.001
Single [d]	0.77±0.78		58.37 (52.61-63.90)		15.92 (11.69-21.31)	
Married	0.72±0.77		54.53 (51.00-58.02)		15.06 (12.44-18.13)	
Living Areas		0.001				
Rural areas	0.58±0.67		48.17 (41.88-54.53)		8.92 (6.29-12.49)	
Urban areas	0.79±0.80		57.95 (54.39-61.42)		17.88 (15.27-20.82)	
Medical insurance		0.001		0.001		0.001
Uninsured	0.67±0.74		51.81 (45.43-58.12)		13.72 (11.19-16.71)	
Insured	0.73±0.77		55.07 (51.30-58.78)		15.20 (12.34-18.58)	

Note: [a] Weighted estimates of prevalence of with proportional to population size and post-stratification sample weights adjustment.

[b] Differences between categories within each variable, Chi-square test for each variable.

[c] Differences between means within each variable, t test for independent samples for gender, marital status, register status, living areas, medical insurance; one-way analysis of variance (ANOVA) for age group, education level.

[d] Single: unmarried, divorced or widowed.

CI: confidence interval; SD: standard deviation.

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Table 2. Associations between socio-demographic and comorbidity characteristics in community-dwelling elderly people in Guangzhou, China

Variables	Hypertension OR (95% CI)[a]	P	Diabetes OR (95% CI)[a]	P	Coronary heart disease OR (95% CI)[a]	P	Apoplexy OR (95% CI)[a]	P	Morbidity OR (95% CI)[a]	P	Multimorbidity OR (95% CI)[a]	P
Age groups, years												
65-74	Reference		Reference		Reference		Reference		Reference		Reference	
75-84	1.59 (1.58–1.60)	0.001	1.19 (1.18–1.21)	0.001	1.65 (1.61–1.68)	0.001	1.20 (1.16–1.25)	0.001	1.50 (1.49–1.52)	0.001	1.55 (1.53–1.57)	0.001
≥85	1.87 (1.84–1.90)	0.001	0.97 (0.95–0.99)	0.004	1.98 (1.91–2.05)	0.001	1.43 (1.35–1.53)	0.001	1.68 (1.66–1.71)	0.001	1.47 (1.44–1.50)	0.001
Gender												
Male	Reference		Reference		Reference		Reference		Reference		Reference	
Female	1.14 (1.13–1.15)	0.001	1.26 (1.25–1.28)	0.001	1.21 (1.18–1.23)	0.001	0.69 (0.67–0.72)	0.001	1.14 (1.13–1.15)	0.001	1.20 (1.19–1.22)	0.001
Education levels												
No school	Reference		Reference		Reference		Reference		Reference		Reference	
Primary school	1.03 (1.02–1.05)	0.001	1.03 (1.02–1.05)	0.001	2.01 (1.93–2.08)	0.001	1.43 (1.35–1.52)	0.001	1.04 (1.03–1.06)	0.001	1.23 (1.21–1.25)	0.001
Secondary school	0.83 (0.82–0.84)	0.001	0.97 (0.96–0.99)	0.002	2.72 (2.62–2.82)	0.001	0.97 (0.91–1.03)	0.331	0.84 (0.83–0.85)	0.001	1.28 (1.26–1.31)	0.001
College and above	0.92 (0.90–0.94)	0.001	1.03 (1.01–1.06)	0.025	3.23 (3.09–3.38)	0.001	1.16 (1.07–1.26)	0.001	0.97 (0.95–0.99)	0.002	1.38 (1.34–1.42)	0.001
Marital status												
Married	Reference		Reference		Reference		Reference		Reference		Reference	
Single [b]	1.10 (1.08–1.11)	0.001	1.07(1.05–1.09)	0.001	1.04 (1.01–1.07)	0.018	0.61 (0.58–0.64)	0.001	1.05 (1.04–1.06)	0.001	1.07 (1.05–1.08)	0.001
Living Areas												
Urban areas	Reference		Reference		Reference		Reference		Reference		Reference	
Rural areas	0.70 (0.70–0.71)	0.001	0.68 (0.67–0.69)	0.001	0.31 (0.30–0.32)	0.001	0.53 (0.50–0.55)	0.001	0.67 (0.67–0.68)	0.001	0.49 (0.48–0.49)	0.001
Medical insurance												
Insured	Reference		Reference		Reference		Reference		Reference		Reference	
Uninsured	0.85 (0.83–0.87)	0.001	1.06 (1.03–1.10)	0.001	0.72 (0.67–0.77)	0.001	1.44 (1.30–1.59)	0.001	0.92(0.89–0.94)	0.001	0.90 (0.87–0.94)	0.001

Note: [a] Adjusted for all variables listed in the table. OR, odds ratio; CI, confidence interval.

[b] Single: unmarried, divorced or widowed.

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Table 3. The pattern of multimorbidity based on Mining Association Rules of Apriori algorithm in community-dwelling elderly people in Guangzhou, China

Left hand side	Right hand side	Support (%)	Confidence (%)	*lift*
Diabetes[a]	Hypertension	12.495	17.579	1.404
Coronary heart disease [a]	Hypertension	4.377	5.718	1.512
Coronary heart disease [a]	Diabetes	1.615	5.718	1.606
Coronary heart disease, Hypertension [b]	Diabetes	1.385	4.377	1.799

Note: [a] The results of association rules for relationship between chronic diseases with 1 left-hand-side.

[b] The results of association rules for relationship between chronic diseases with 2 left-hand-side.

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Figure 1: Sampling framework in this study in Guangzhou, China
Note: CHCs: Community health centers.

Figure 2: Prevalence of chronic conditions by region in community-dwelling elderly people in Guangzhou, China
Note: a Prevalence of Hypertension.
b Prevalence of Diabetes.
c Prevalence of Coronary heart disease.
d Prevalence of Apoplexy.
e Prevalence of Morbidity.
f Prevalence of Multimorbidity.

Figure 3: Number of chronic conditions by age group in community-dwelling elderly people in Guangzhou, China

Figure 4. Number of chronic conditions in community-dwelling elderly people in Guangzhou, China

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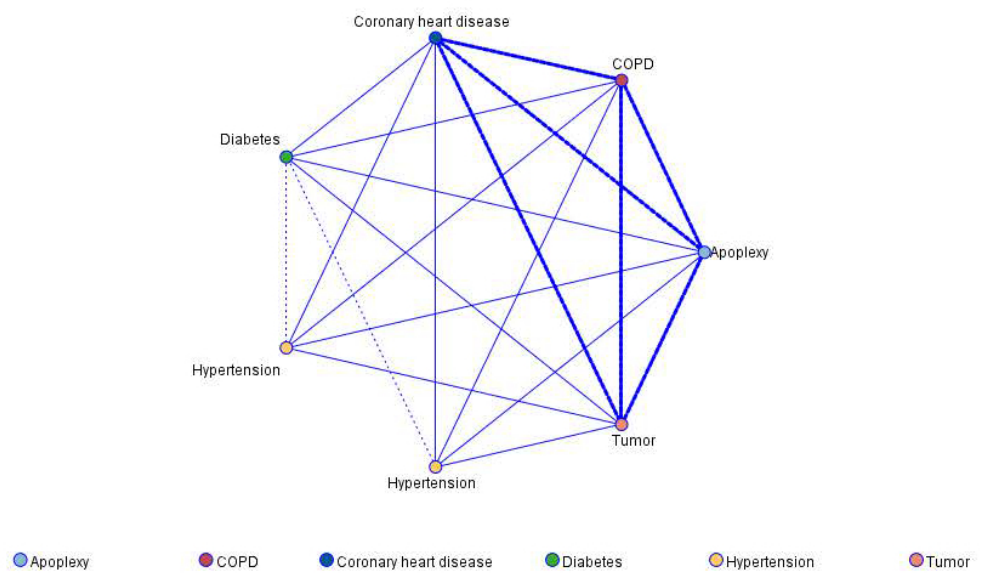
Figure 5. Web diagram of comorbidity in community-dwelling elderly people in Guangzhou, China

Conflict of Interest and Credit Author Statement

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. We further confirm that any aspect of the work covered in this manuscript that has involved people has been conducted with the ethical approval of all relevant bodies.

We understand that the Corresponding Author is the sole contact for the Editorial process (including Editorial Manager and direct communications with the office). He is responsible for communicating with the other authors about progress, submissions of revisions and final approval of proofs. We confirm that we have provided a current, correct email address which is accessible by the Corresponding Author.

Article: Prevalence and patterns of multimorbidity in chronic diseases in Guangzhou, China: a data mining study in the residents' health records system among 31,708 community-dwelling elderly people

Contributions: WQL, CW, YHL, LL, YOY, DW, and GZL supervised the study data collection and quality control. WQL, HL and GZL conducted the literature review. WQL and EML conducted the data analyses. WQL, LXY and MYS drafted the manuscript, WQL and HL finalized the manuscript with inputs from all authors.

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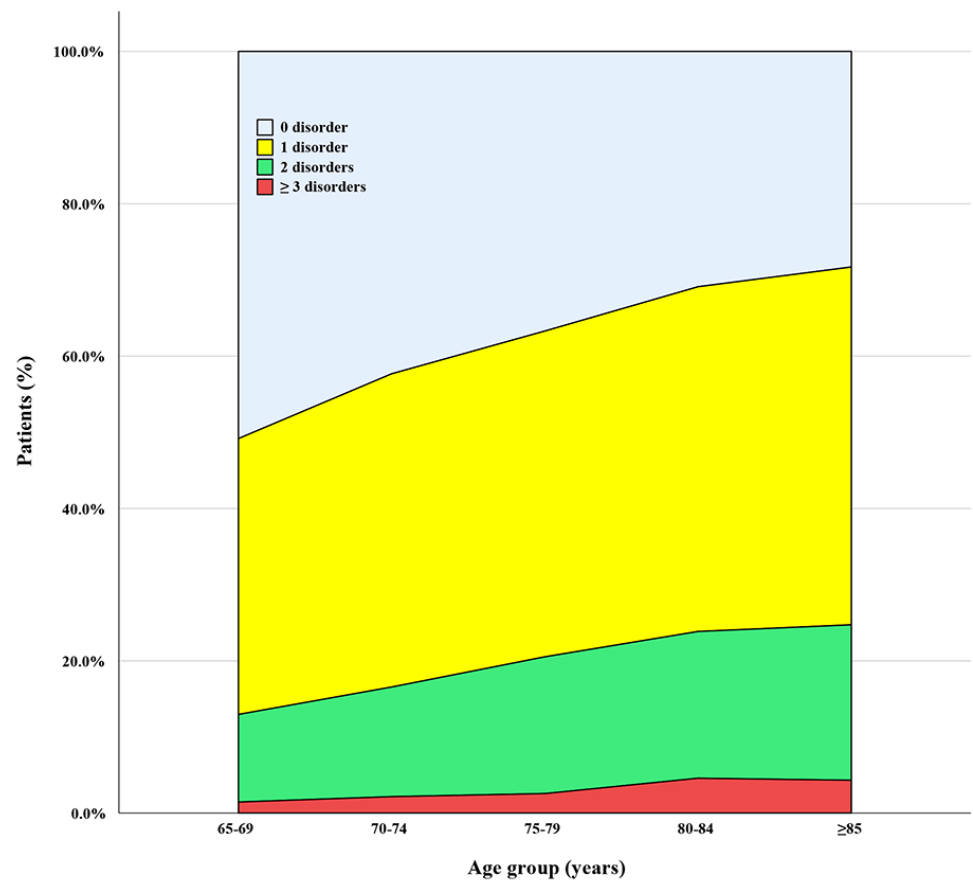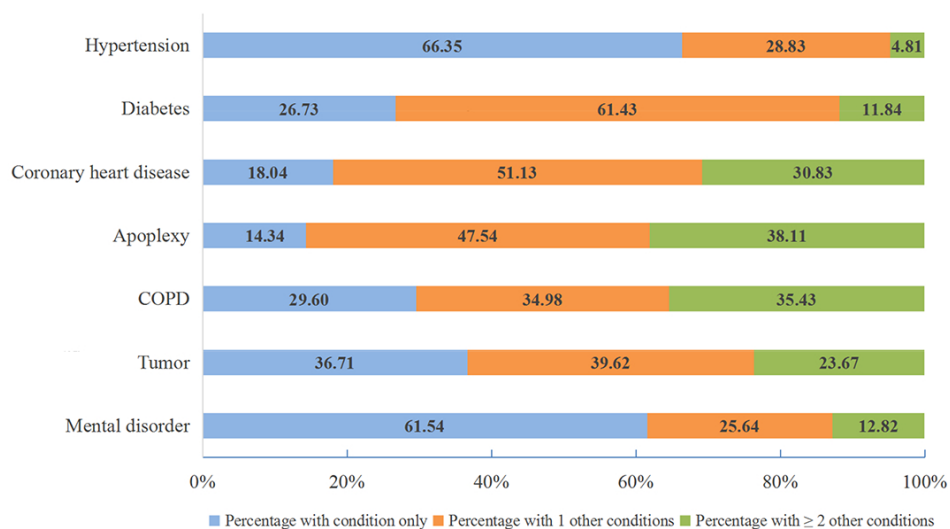47
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Li, Lan Liu, Yun-Ou Yang, Di Wu, Guo-Zhen Lin, Hui Liu

August 3, 2021

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page Numbers
Title and abstract	1	(*a*) Prevalence and patterns of multimorbidity in chronic diseases in Guangzhou, China: a data mining study in the residents' health records system among 31,708 community-dwelling elderly people	1
		(*b*) The prevalence of morbidity was 54.99% (95%CI: 40.11%-60.11%) and the multimorbidity was 15.17% (95%CI: 12.38%-18.44%) among 31,708 community-dwelling elderly people in Guangzhou, China. Elderly, female, higher education level, being single, living in urban areas and having medical insurance were more likely to have chronic diseases and multimorbidity. Our data included seven prevalent chronic conditions, most of which accompanied with one or more other chronic diseases. Our study also reveals several patterns of multimorbidity among elderly residents in Guangzhou, including coexistence of hypertension and diabetes, hypertension and coronary heart disease, diabetes and coronary heart disease, diabetes, coronary heart disease and hypertension. A high prevalence of morbidity and a relatively low multimorbidity of chronic diseases exist in elderly people. Data mining of residents' health records will help for strengthening the management of residents' health records in community health service centers of Guangzhou, China.	3~4
Introduction			**5~7**
Background/rationale	2	Multimorbidity led to serious consequences for elderly people. Data mining of electronic health records was a novel way to understand disease morbidity and multimorbidity among elderly residents. However, studies with application of electronic health records in community health service centers are limited in China.	5~6
Objectives	3	This study aimed to estimated the prevalence of chronic diseases, multimorbidity and patterns of multimorbidity in Guangzhou, China.	7
Methods			**7~8**
Study design	4	A cross-sectional study	7
Setting	5	This study conducted in Guangzhou City, China. A total of 31,708 community-dwelling older adults (aged ≥65 years) were recruited by multistage, stratified random sampling.	7
Participants	6	Cross-sectional study 1) Resident of Guangzhou City, China; 2) aged 65 years or older; 3) established residents' health records in community health service centers.	7
Variables	7	Data on age, gender, marital status, educational level, living areas, medical insurance, and the past medical history were collected in residents' health records in this study.	7
Data sources/ measurement	8*	Prevalence of chronic diseases, multimorbidity; Patterns of multimorbidity	7
Bias	9	Selection bias and recall bias.	7
Study size	10	A total of 31,708 community-dwelling older adults (aged ≥ 65 years) were recruited by multistage, stratified random sampling.	7
Quantitative variables	11	Prevalence of chronic diseases	7

Statistical methods	12	Statistical analysis was performed using R and SPSS 21.0 (SPSS Inc., Chicago, IL). The Chi-square, t-test and one-way analysis of variance (ANOVA), were used to assess the differences in socio-demographic characteristics between subjects. Binary logistic regression analysis was conducted to examine factors associated with chronic diseases and multimorbidity, and a forward stepwise selection strategy was adopted when the regression models performed. To increase the representativeness of the study population, all statistics were calculated by using base weights adjustment (population weight and post-stratification sample weights). The complex samples module in SPSS 21.0 was adopted to account for the multistage sample design. Geographic heat map of chronic diseases were draw by R 3.2.1 program. The association rule mining analysis was used to explore the correlations and patterns of multimorbidity between chronic diseases among community-dwelling elderly people. $P < 0.05$ was considered statistically significant in the present study.	8
Results				**9~10**
Participants	13*	A total of 31,708 community-dwelling older adults (aged $\geqslant$ 65 years) were recruited by multistage, stratified random sampling.	9
Descriptive data	14*	In this study, we found that the prevalence were 54.99% for morbidity and 15.17% for multimorbidity, and which were associated with several factors among 31,708 community-dwelling elderly people.	9
Outcome data	15*	Prevalence of chronic diseases, multimorbidity; Patterns of multimorbidity	9
Main results	16	Elderly, female, higher education level, being single, living in urban areas and having medical insurance were more likely to have chronic diseases and multimorbidity. Our data included seven prevalent chronic conditions, most of which accompanied with one or more other chronic diseases. Our study also reveals several patterns of multimorbidity among elderly residents in Guangzhou, including coexistence of hypertension and diabetes, hypertension and coronary heart disease, diabetes and coronary heart disease, diabetes, coronary heart disease and hypertension.	9~10
Other analyses	17	No.	-
Discussion				**10~15**
Key results	18	A high prevalence of morbidity and a relatively low multimorbidity of chronic diseases exist in elderly people. Data mining of residents' health records will help for strengthening the management of residents' health records in community health service centers of Guangzhou, China.	10
Limitations	19	Some limitations were included in this study. Firstly, although the sample size was enough, the number of chronic diseases were small in this study. Secondly, the prevalence of major chronic diseases was consisted with results of the national health survey, but some chronic diseases were lower than other studies, such as apoplexy, COPD, and tumor. Those may lead to a low prevalence of multimorbidity. At the same time, the residents' health records in communities were based on self-reporting; thus, the selection bias and recall bias were introduced. Therefore, a larger and prospective cohort design based on residents'	14

			health records to infer the causal relationship is needed in future research.	
Interpretation	20		Some strengths were also included in present study. There are few studies on data mining of residents' health records in community health service centers in China. In the present study, a multistage, stratified random sampling method was selected, and 31,708 elderly people were adopted, which can explore representatively the current status and quality of residents' health records of Guangzhou, southern of China. And the results will help for strengthening the management of residents' health records in community health service centers of Guangzhou, China.	11
Generalisability	21		These findings may provide useful information for multifactorial interventions of multimorbidity and strengthening the management of residents' health records in community health service centers of Guangzhou, China.	15
Other information				**16**
Funding	22		This study was supported by National Natural Science Foundation of China (72072191); The Key Project of Medicine Discipline of Guangzhou (No.2021-2023-12); Basic Research Project of Key Laboratory of Guangzhou (No.202102100001), and The Science Technology Project of Guangzhou Municipal Health Commission (20191A011054, 20201A011058, 20201A011064).	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Prevalence and patterns of multimorbidity in chronic diseases in Guangzhou, China: a data mining study in the residents' health records system among 31,708 community-dwelling elderly people

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Primary Subject Heading:	Geriatric medicine
Secondary Subject Heading:	Epidemiology
Keywords:	Hypertension < CARDIOLOGY, Public health < INFECTIOUS DISEASES, PRIMARY CARE

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Prevalence and patterns of multimorbidity in chronic diseases in Guangzhou, China: a data mining study in the residents' health records system among 31,708 community-dwelling elderly people

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2

Abstract

Objectives Examination of the prevalence, influence factors and patterns of multimorbidity among the elderly people in Guangzhou, China.

Design Cross-sectional study.

Participants 31,708 community-dwelling elderly people aged 65 and over.

Primary and secondary outcome measures Prevalence, influence factors and patterns of multimorbidity in 7 chronic conditions among the participants. A multistage, stratified random sampling was adopted for selection of health records in the residents' health records system of Guangzhou. Data mining by association rule mining analysis was used to explore the correlations and multimorbidity patterns between seven chronic diseases.

Results The prevalence of morbidity was 55.0% (95%CI: 40.1%-60.1%) and the multimorbidity was 15.2% (95%CI: 12.4%-18.4%) among the participants. Elderly, female, higher education level, being single, living in urban areas and having medical insurance were more likely to have chronic diseases and multimorbidity. Data mining by association rule mining analysis reveals patterns of multimorbidity among the participants, including coexistence of hypertension and diabetes (Support:12.5%, Confidence:17.6%), hypertension and coronary heart disease (Support:4.4%, Confidence:5.7%), diabetes and coronary heart disease (Support:1.6%, Confidence:5.7%), diabetes, coronary heart disease and hypertension (Support:1.4%, Confidence:4.4%).

Conclusions A high prevalence of morbidity (especially on Hypertension and

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49 Diabetes) and a relatively low multimorbidity of chronic diseases exist in elderly

50 people. Data mining of residents' health records will help for strengthening the

51 management of residents' health records in community health service centers of

52 Guangzhou, China.

53 ***Keywords:*** Chronic diseases; Patterns of multimorbidity; Data Mining; Elderly people

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Strengths and limitations of this study

57 The report on data mining of electronic health records in community health service

58 centers are limited in China.

59 31,708 elderly people health records were adopted by a multistage, stratified

60 random sampling method.

61 Selection bias and recall bias were introduced in this study.

62 Only 7 chronic diseases were included in this study.

63 The prevalence of chronic diseases and multimorbidity may be underestimated in

64 this study.

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66   **Introduction**

67   China is experiencing a rapidly growing aging population. Data from seventh national

68   census of National Bureau of Statistic in China showed that individuals aged 65 years

69   or older constitute about 13.5% (191 million) of the total population in 2020.[1] With

70   the population aging, chronic diseases have become an important public health

71   challenge in China. It is estimated that chronic diseases will cause 122 million people

72   deaths in China in 2030, and the mortality rate of chronic diseases would increase up

73   to 40.0% (859.2 *vs* 613.5/100, 000) compared to 2013.[2] What makes the situation

74   worse is multimorbidity, which is defined as the co-existence of two or more chronic

75   diseases in one person,[3] has increasingly gained attention in recent decades.

76   Multimorbidity is associated with poor health outcomes, such as reduced function

77   levels (ability of activities of daily living), increased psychological distress,[4, 5]

78   impaired quality of life,[6, 7] and increased rates of disability and mortality.[8, 9] Moreover,

79   chronic diseases and multimorbidity can cause the heavy illness and treatment burden,

80   especially in elderly population. [10] It was reported that 72.7% of outpatient services

81   and 77.3% of inpatient services were used by patients with multimorbidity.[11] Another

82   study in Beijing China reported that the expenditure on elderly people with two and

83   three conditions was 3.4 times and 5.3 times higher than that on elderly people with a

84   single condition.[12]

85   Although reported previously,[13, 14] the prevalence and pattern of multimorbidity

86   among elderly people varied significantly. The overall prevalence of multimorbidity

87   ranged from 6.4% to 76.5% in the elderly people in China,[15, 16] even, 90.5% among

88   older Chinese adults living in rural areas.[17] The wide variations in prevalence of

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89 multimorbidity in those studies may be related to differences of the included diseases,

90 the assessment methods and instruments, differences in environment and lifestyles,

91 and so on. For example, a systematic review study in South Asia found that

92 prevalence of multimorbidity ranged from 4.5% to 83%, and the included number of

93 diseases in a given study varied from 7 to 22.[18] Meanwhile, the various patterns of

94 multimorbidity were reported in different studies, which used different statistical

95 methods, such as factor analysis, cluster analysis, and association rule mining analysis.

96 The common multimorbidity patterns included pattern of osteoarthritis and

97 rheumatoid arthritis with hypertension,[19] pattern of hypertension and diabetes,[6] pattern

98 of cardiopulmonary mental degenerative disorder, pattern of cerebrovascular

99 metabolic disorder,[17] and so on. Nonetheless, it is indisputable that multimorbidity is

100 prevalent among elderly people in China.

101   The project of health records of residents in community health service centers, one

102 of the national basic public health service projects, has been implemented in China.

103 As part of the national project, the city of Guangzhou established an electronic health

104 record system since 2010.[20] To 2020, 91.23% residents of Guangzhou have

105 established health records in their community health service centers in different

106 districts. Data mining of electronic health records thus becomes a novel way to

107 understand disease morbidity and multimorbidity among residents. However, studies

108 with application of electronic health records in community health service centers are

109 limited in China.

110   By taking advantage of the abundant data, we therefore set out a data mining study

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111   in the electronic health record of residents in community health service centers of

112   Guangzhou. We aim to assess prevalence and influence factors of chronic diseases

113   and multimorbidity and to explore patterns of multimorbidity among

114   community-dwelling elderly people in Guangzhou, China.

115

Methods

Study design and Data Source

118   From October to December 2020, a multistage, stratified random sampling was

119   adopted for selection of residents' health records in Guangzhou. Firstly, based on the

120   population per district, we selected 2, 4, or 6 community health service centers in each

121   district (**Figure 1**). Secondly, in each selected community health service center, we

122   further selected 2 sub-district community health service centers, and all

123   community-dwelling residents' health records were adopted. Finally, among them,

124   31,708 health records were derived from residents aged 65 years or above. The

125   sampling framework was showed in detail in **Figure 1**.

Patient and public involvement

127   Patients or public were not involved in study design or conduct of the study. There are

128   no plans to disseminate the research results to study participants.

Instruments

Socio-demographic Characteristics

131   The socio-demographic information, including age, gender, marital status,

132   educational level, living area, and medical insurance were selected in residents' health

7

133   records in the present study.

134   **Morbidity coding**

135   All the 7 chronic conditions were reported in the past medical history in residents'

136   health records in community health service centers, which were selected in the present

137   study. International Classification of Diseases (ICD-10) codes was used for all

138   diagnoses. And the 7 chronic conditions as following: Hypertension (I10.x09),

139   Diabetes (E11.900), Coronary heart disease (I25.103), Apoplexy (I64.x00), COPD

140   (J44.900), Tumor (M80000/3) and Mental disorder (F99.x00). For this study,

141   multimorbidity was defined as the co-existence of two or more chronic conditions in

142   one person.[3]

143   *Data analyses*

144   Statistical analysis was performed using R and SPSS 21.0 (SPSS Inc., Chicago, IL).

145   Sample size was calculated by the formula, $n = (Z_a^2 \times P_0 (1- P_0))/d^2$. With the data of

146   elderly adults in southwest China, P_0 was 16.1%,[14] d was $0.1P_0$, a was 0.05, the

147   minimal sample size of 2084 participants was required. The Chi-square, t-test and

148   one-way analysis of variance (ANOVA), were used to assess the differences in

149   socio-demographic characteristics between subjects. Binary logistic regression

150   analysis was conducted to examine factors associated with chronic diseases and

151   multimorbidity, and a forward stepwise selection strategy was adopted when the

152   regression models performed. To increase the representativeness of the study

153   population, all statistics were calculated by using base weights adjustment (population

154   weight and post-stratification sample weights). The complex samples module in SPSS

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155   21.0 was adopted to account for the multistage sample design. Geographic heat map

156   of chronic diseases were draw by R 3.2.1 program. The association rule mining

157   analysis was used to explore the correlations and patterns of multimorbidity between

158   chronic diseases among community-dwelling elderly people. *P* < 0.05 was considered

159   statistically significant in the present study.

160

161   **Results**

162   Seven chronic conditions in the residents' health records system among 31,708

163   community-dwelling elderly people exist in Guangzhou (**Table 1**). The prevalence of

164   morbidity was 55.0% (95%CI: 40.1%-60.1%) and the most common chronic disease

165   was hypertension (47.8%, 95%CI: 44.5%-51.0%). Prevalence of Other selected

166   chronic conditions was also reported, including 15.9% (95%CI: 14.4%-17.6%) for

167   diabetes, 4.9% (95%CI: 3.0%-7.8%) for coronary heart disease, 1.3% (95%CI:

168   0.8%-2.1%) for apoplexy, 0.7% (95%CI: 0.4%-1.4%) for COPD, 1.3% (95%CI:

169   0.8%-2.0%) for tumor and 0.5% (95%CI: 0.3%-0.7%) for mental disorder.

170   The prevalence of chronic conditions in community-dwelling elderly people

171   showed regional differences in Guangzhou China (**Figure 2**). According to the heat

172   map of prevalence by region, elderly people living in urban areas were more likely to

173   have chronic conditions. The risk of morbidity and multimorbidity in elderly people

174   was growing up as people get older (**Figure 3**). Half of the people aged 65-69 had at

175   least one disorder and the number gradually increased with age.

176   Of the 31,708 respondents, 15.2% (95%CI: 12.4%-18.4%) of elderly people had

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177   multimorbidity (**Table 1**). Results of logistic regression analysis showed that

178   socio-demographic factors associated with morbidity and multimorbidity (**Table 2**).

179   Elderly, female, higher education level, being single, living in urban areas and having

180   medical insurance were more likely to have chronic diseases and multimorbidity.

181   Results of data mining study by association rule mining analysis showed that seven

182   selected chronic conditions, most of them accompanied with one or more other

183   chronic diseases. **Figure 4** showed that 66.4% of elderly people with hypertension

184   had only one condition (hypertension), while 33.7% experienced one or more

185   additional chronic diseases (multimorbidity). On the contrary, 85.7% of elderly people

186   with apoplexy reported experiencing one or more additional chronic diseases

187   (multimorbidity), only 14.3% of those had apoplexy alone. Moreover, web diagram

188   analysis revealed that these chronic diseases were highly related to each other (**Figure**

189   **5**).

190   **Table 3** showed the patterns of multimorbidity in the present study, and the most

191   common pattern of multimorbidity was model of hypertension and diabetes

192   (Support:12.5%, Confidence:17.6%). Meanwhile, model of hypertension and

193   coronary heart disease (Support:4.4%, Confidence:5.7%), model of diabetes and

194   coronary heart disease (Support:1.6%, Confidence:5.7%), model of diabetes, coronary

195   heart disease and hypertension (Support:1.4%, Confidence:4.4%) were also reported.

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197   **Discussion**

198   **Main Findings**

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199   In this study, we found that the prevalence were 55.0% for morbidity and 15.2% for

200   multimorbidity, and which were associated with several factors among 31,708

201   community-dwelling elderly people. Data mining of association rule mining analysis

202   can explore the correlations and patterns of multimorbidity between chronic diseases,

203   which will help for strengthening the management of residents' health records in

204   community health service centers of Guangzhou, China.

205   **Comparison with Previous Studies**

206   Chronic diseases are becoming more and more common and their prevalence is

207   rapidly increasing.[21] In the present study, the prevalence of morbidity was 55.0%

208   among elderly people in Guangzhou, China, which was similar to previous studies. [14]

209   47.8%, 15.9%, 4.9% of elderly people with hypertension, diabetes, coronary heart

210   disease, respectively, which was consistent with previous studies. [13, 14, 22, 23] In the

211   present study, we found that the prevalence of multimorbidity was 15.2% among

212   31,708 community-dwelling elderly people in Guangzhou, China, which is consistent

213   with previous reports from Li and colleagues (16.1% among the elderly adults aged

214   ≥60 years in southwest China),[14] and Bao and colleagues (20.8% of middle-aged and

215   elderly residents in southern China).[6] However, Zhang and colleagues found that

216   multimorbidity was 43.6% of elderly people in a nationally representative sample of

217   China,[13] and Yao and colleagues found that multimorbidity occurred in 42.4% of the

218   participants from the China Health and Retirement Longitudinal Study.[24] Moreover,

219   Wang and colleagues found that multimorbidity prevalence was 81.3% among one

220   million older group in China, even, 90.5% among older adults living in rural areas of

11

221 China.[17] Compare with those studies, the wide variations in prevalence of

222 multimorbidity may due to differences of the included chronic diseases and the

223 assessment method and instrument. In the present study, only seven chronic

224 conditions were included. And the assessment method and instrument were based on

225 residents' health records in community health service centers of Guangzhou, the

226 imperfection of residents' health records may also contribute to low prevalence.

227 Nevertheless, chronic diseases and multimorbidity should not be overlooked among

228 community-dwelling elderly people.

229   We found that age was associated with multimorbidity. With aging the prevalence

230 of multimorbidity was higher. [25, 26] With aging and immunity declining, risk of

231 illnesses will increase naturally among elderly people. Study of China Kadoorie

232 Biobank was found that a higher increase in the number of chronic conditions was

233 found in the older people.[27] The prevalence of multimorbidity was higher among

234 women[25] and living in urban areas,[23, 27] which was consisted with previous studies.[24]

235 Elderly people in rural areas may have limited medical resources than urban residents,

236 which might lead to a lower probability of being diagnosed. Interestingly, higher

237 education level and having medical insurance were also found to be associated with

238 higher prevalence of multimorbidity.[26] People of higher education level generally had

239 higher health literacy level and had more healthcare-seeking behaviors; meanwhile,

240 regular physical examinations in elderly people who had medical insurance also

241 helped them of being diagnosed. Compare with married status, elderly people being

242 single (unmarried, divorced or widowed) was positively associated with

243 multimorbidity.[28] One alternative explanation might be that loneliness may result in a

244 higher risk of multimorbidity.[29] Loneliness can cause emotional changes, which in

245 turn affect multimorbidity,[30] and these emotional changes can activate neurobiological

246 and behavioral mechanisms which can decrease health. [31]

247 Cluster analysis and association rule mining analysis are the common data mining

248 methods to calculating the associations between different diseases. Different from

249 cluster analysis, association rule mining analysis can directly calculate the probability

250 of multimorbidity, when participants had a chronic disease. Therefore, association

251 rule mining analysis was adopted for analyzing patterns of multimorbidity in the

252 present study, and the most common pattern of multimorbidity was reported: model of

253 hypertension and diabetes. Specifically, when the elderly people have diabetes,

254 17.58% of them are more likely to have hypertension (**Table 3**). Similar result was

255 reported in a prospective cohort study, prevalent of multimorbidity of

256 diabetes-hypertension was 12.5%.[32] Blümel and colleagues found that hypertension

257 coexisted in 22.0% of women with diabetes.[33] Prathapan and colleagues found that a

258 fourth of the sample were affected by multimorbidity of diabetes and hypertension,

259 and the combinations of coronary heart disease with hypertension and diabetes were

260 also significantly prevalent.[34] Bao and colleagues demonstrated that the most

261 prevalent chronic diseases pair was hypertension and diabetes among community

262 middle-aged and elderly residents in southern China.[6] Meanwhile, in the present study,

263 model of hypertension and coronary heart disease, model of diabetes and coronary

264 heart disease, model of diabetes, coronary heart disease and hypertension were also

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265 reported. A nationally representative sample of middle-aged and older adults study

266 showed that three top prevalent multimorbidity combinations were, diabetes arthritis

267 hypertension; diabetes hypertension; and diabetes arthritis hypertension heart disease.

268 [32] Other study of community-dwelling elderly people in Nanjing, China, found that

269 hypertension and diabetes, hypertension and coronary heart disease, hypertension and

270 dyslipidemia, diabetes and cataract, diabetes and hearing disorder, hypertension and

271 stroke were the common patterns of multimorbidity.[16] Exploring patterns of

272 multimorbidity may contribute to implement the effective prevention, interventions,

273 treatment measures and management strategies of multimorbidity, and more attention

274 are required for researchers.

275 Some limitations were included in this study. Firstly, only 7 chronic diseases were

276 included in this study. Secondly, the old records (invalid records) or deaths records

277 were not included. Thirdly, some chronic diseases were lower than other studies, such

278 as apoplexy, COPD, and tumor. Those may lead to a low prevalence of

279 multimorbidity. At the same time, the residents' health records in communities were

280 based on self-reporting; thus, the selection bias and recall bias were introduced.

281 Therefore, a larger and prospective cohort design based on residents' health records to

282 infer the causal relationship is needed in future research.

283 Some strengths were also included in present study. There are few studies on data

284 mining of residents' health records in community health service centers in China. In

285 the present study, a multistage, stratified random sampling method was selected, and

286 31,708 elderly people were adopted, which can explore representatively the current

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287   status and quality of residents' health records in community health service centers of

288   Guangzhou, southern of China. And the results will help for strengthening the

289   management of residents' health records of Guangzhou, China.

290   **Conclusions**

291   Our study indicated that a high prevalence of morbidity and a relatively low

292   multimorbidity of chronic diseases among 31,708 community-dwelling elderly people

293   in Guangzhou, China. Elderly, female, higher education level, being single, living in

294   urban areas and having medical insurance were more likely to have chronic diseases

295   and multimorbidity. Data mining of residents' health records in community health

296   service centers by association rule mining analysis showed that pattern of

297   multimorbidity were model of hypertension and diabetes, model of hypertension and

298   coronary heart disease, model of diabetes and coronary heart disease, model of

299   diabetes, coronary heart disease and hypertension.

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302   their kind assistance in data collection.

303   **Contributions**

304   WQL, CW, YHL, LL, YOY, DW, and GZL supervised the study data collection and

305   quality control. WQL, HL and GZL conducted the literature review. WQL and EML

306   conducted the data analyses. WQL, LXY and MYS drafted the manuscript, WQL and

307   HL finalized the manuscript with inputs from all authors.

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Competing interests

315 None declared.

Patient consent for publication

317 Not required.

Ethics approval

319 Ethical approval for this survey was obtained from the Ethics Committee of Center for

320 Disease Control and Prevention of Guangzhou (GZCDC-ECHR-2020P0004). Data

321 were anonymised before the authors accessed them for the purpose of this study.

Provenance and peer review

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Data availability statement

325 No additional data are available.

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405   Disability Among Middle-aged and Older   Adults. *J Gen Intern Med* 2019;**34**:944-51.

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409   multimorbidity in a middle-income country. *Plos One* 2020;**15**:e243614.

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Figure Legend

Figure 1: Sampling framework in this study in Guangzhou, China

Note: CHCs: Community health centers.

Figure 2: Prevalence of chronic conditions by region in community-dwelling elderly people in Guangzhou, China

Note: [a] Prevalence of Hypertension.
  [b] Prevalence of Diabetes.
  [c] Prevalence of Morbidity.
  [d] Prevalence of Multimorbidity.

Figure 3: Number of chronic conditions by age group in community-dwelling elderly people in Guangzhou, China

Figure 4. Number of chronic conditions in community-dwelling elderly people in Guangzhou, China

Figure 5. Web diagram of comorbidity in community-dwelling elderly people in Guangzhou, China

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Table 1. Socio-demographic and comorbidity characteristics in community-dwelling elderly people in Guangzhou, China

Variables	Total		Prevalence of hypertension (95% CI)[a]	P^b	Prevalence of diabetes (95% CI)[a]	P^b	Prevalence of coronary heart disease (95% CI)[a]	P^b	Prevalence of apoplexy (95% CI)[a]	P^b
	n	%								
All participants	31708	100.00	47.76 (44.54-50.99)		15.94 (14.38-17.64)		4.90 (3.02-7.84)		1.33 (0.84-2.09)	
Age groups, years				0.001		0.001		0.001		0.001
65-74	19853	62.61	42.34 (39.32-45.43)		14.99 (13.82-16.25)		3.98 (2.48-6.32)		1.15 (0.78-1.70)	
75-84	9023	28.46	55.29 (50.96-59.53)		17.93 (15.56-20.57)		6.26 (3.88-9.94)		1.53 (0.88-2.65)	
≥85	2832	8.93	59.91 (54.35-65.23)		15.37 (11.71-19.91)		6.65 (3.63-11.86)		1.88 (0.99-3.54)	
Gender				0.001		0.001		0.001		0.001
Male	14046	44.30	45.33 (42.09-48.61)		14.32 (12.78-16.01)		4.66 (2.97-7.24)		1.51 (0.96-2.36)	
Female	17662	55.70	49.85 (46.56-53.14)		17.33 (15.66-19.15)		5.10 (3.06-8.39)		1.17 (0.73-1.88)	
Education levels				0.001		0.001		0.001		0.001
No school	3372	10.63	51.63 (45.22-57.98)		15.73 (12.59-19.48)		2.31 (1.27-4.18)		1.12 (0.47-2.67)	
Primary school	11258	35.51	49.98 (45.94-54.01)		16.19 (14.12-18.49)		4.31 (2.70-6.79)		1.58 (0.92-2.70)	
Secondary school	12668	39.95	43.90 (40.32-47.55)		15.56 (14.34-16.87)		5.82 (3.47-9.63)		1.14 (0.76-1.71)	
College and above	4410	13.91	50.22 (45.26-55.17)		17.42 (14.67-20.56)		8.56 (6.36-11.42)		1.61 (1.05-2.47)	
Marital status				0.001		0.020		0.004		0.001
Single [d]	3685	11.62	50.88 (44.98-56.75)		16.18 (14.23-18.33)		5.07 (2.87-8.80)		2.00 (1.04-3.81)	
Married	28023	88.38	47.34 (44.34-50.36)		15.91 (14.29-17.68)		4.87 (3.03-7.74)		1.24 (0.81-1.89)	
Living Areas				0.001		0.001		0.001		0.001
Rural areas	6447	20.33	41.71 (35.60-48.09)		12.47 (10.54-14.70)		1.63 (0.89-2.94)		0.82 (0.43-1.56)	
Urban areas	25261	79.67	50.38 (47.03-53.74)		17.45 (16.24-18.73)		6.32 (4.04-9.75)		1.55 (1.00-2.39)	
Medical insurance				0.001		0.001		0.001		0.001
Uninsured	1126	3.55	42.37 (36.63-48.32)		16.95 (13.55-20.98)		3.52 (2.48-4.99)		1.79 (1.13-2.82)	
Insured	30582	96.45	47.90 (44.58-51.23)		15.92 (14.32-17.65)		4.93 (3.01-7.97)		1.32 (0.83-2.09)	

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Table 1. Socio-demographic and comorbidity characteristics in community-dwelling elderly people in Guangzhou, China *(Continued)*

Variables	Mean of morbidities M± SD	P^c	Prevalence of morbidity (≥ 1 chronic diseases, 95% CI) [a]	P^b	Prevalence of multimorbidity (≥ 2 chronic diseases, 95% CI) [a]	P^b
All participants	0.72±0.77		54.99 (40.11-60.11)		15.17 (12.38-18.44)	
Age groups, years		0.001		0.001		0.001
65-74	0.65±0.74		50.21 (46.95-53.47)		12.87 (10.82-15.23)	
75-84	0.84±0.80		61.77 (56.43-66.84)		18.99 (15.30-23.33)	
≥85	0.87±0.79		65.14 (59.15-70.68)		17.81 (11.56-26.42)	
Gender		0.001		0.001		0.001
Male	0.69±0.76		52.72 (48.94-56.46)		14.06 (11.40-17.22)	
Female	0.75±0.78		56.94 (53.28-60.54)		16.11 (13.19-19.53)	
Education levels		0.001		0.001		0.001
No school	0.72±0.72		57.98 (50.43-65.18)		12.91 (9.51-17.30)	
Primary school	0.74±0.77		57.09 (53.32-60.77)		14.92 (11.70-18.84)	
Secondary school	0.69±0.79		51.37 (47.05-55.68)		15.59 (12.85-18.78)	
College and above	0.81±0.82		58.70 (52.97-64.20)		19.27 (15.65-23.49)	
Marital status		0.001		0.001		0.001
Single [d]	0.77±0.78		58.37 (52.61-63.90)		15.92 (11.69-21.31)	
Married	0.72±0.77		54.53 (51.00-58.02)		15.06 (12.44-18.13)	
Living Areas		0.001				
Rural areas	0.58±0.67		48.17 (41.88-54.53)		8.92 (6.29-12.49)	
Urban areas	0.79±0.80		57.95 (54.39-61.42)		17.88 (15.27-20.82)	
Medical insurance		0.001		0.001		0.001
Uninsured	0.67±0.74		51.81 (45.43-58.12)		13.72 (11.19-16.71)	
Insured	0.73±0.77		55.07 (51.30-58.78)		15.20 (12.34-18.58)	

Note: [a] Weighted estimates of prevalence of with proportional to population size and post-stratification sample weights adjustment.

[b] Differences between categories within each variable, Chi-square test for each variable.

[c] Differences between means within each variable, t test for independent samples for gender, marital status, register status, living areas, medical insurance; one-way analysis of variance (ANOVA) for age group, education level.

[d] Single: unmarried, divorced or widowed.

CI: confidence interval; SD: standard deviation.

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Table 2. Associations between socio-demographic and comorbidity characteristics in community-dwelling elderly people in Guangzhou, China

Variables	Hypertension OR (95% CI)[a]	P	Diabetes OR (95% CI)[a]	P	Coronary heart disease OR (95% CI)[a]	P	Apoplexy OR (95% CI)[a]	P	Morbidity OR (95% CI)[a]	P	Multimorbidity OR (95% CI)[a]	P
Age groups, years												
65-74	Reference		Reference		Reference		Reference		Reference		Reference	
75-84	1.59 (1.58–1.60)	0.001	1.19 (1.18–1.21)	0.001	1.65 (1.61–1.68)	0.001	1.20 (1.16–1.25)	0.001	1.50 (1.49–1.52)	0.001	1.55 (1.53–1.57)	0.001
≥85	1.87 (1.84–1.90)	0.001	0.97 (0.95–0.99)	0.004	1.98 (1.91–2.05)	0.001	1.43 (1.35–1.53)	0.001	1.68 (1.66–1.71)	0.001	1.47 (1.44–1.50)	0.001
Gender												
Male	Reference		Reference		Reference		Reference		Reference		Reference	
Female	1.14 (1.13–1.15)	0.001	1.26 (1.25–1.28)	0.001	1.21 (1.18–1.23)	0.001	0.69 (0.67–0.72)	0.001	1.14 (1.13–1.15)	0.001	1.20 (1.19–1.22)	0.001
Education levels												
No school	Reference		Reference		Reference		Reference		Reference		Reference	
Primary school	1.03 (1.02–1.05)	0.001	1.03 (1.02–1.05)	0.001	2.01 (1.93–2.08)	0.001	1.43 (1.35–1.52)	0.001	1.04 (1.03–1.06)	0.001	1.23 (1.21–1.25)	0.001
Secondary school	0.83 (0.82–0.84)	0.001	0.97 (0.96–0.99)	0.002	2.72 (2.62–2.82)	0.001	0.97 (0.91–1.03)	0.331	0.84 (0.83–0.85)	0.001	1.28 (1.26–1.31)	0.001
College and above	0.92 (0.90–0.94)	0.001	1.03 (1.01–1.06)	0.025	3.23 (3.09–3.38)	0.001	1.16 (1.07–1.26)	0.001	0.97 (0.95–0.99)	0.002	1.38 (1.34–1.42)	0.001
Marital status												
Married	Reference		Reference		Reference		Reference		Reference		Reference	
Single [b]	1.10 (1.08–1.11)	0.001	1.07 (1.05–1.09)	0.001	1.04 (1.01–1.07)	0.018	0.61 (0.58–0.64)	0.001	1.05 (1.04–1.06)	0.001	1.07 (1.05–1.08)	0.001
Living Areas												
Urban areas	Reference		Reference		Reference		Reference		Reference		Reference	
Rural areas	0.70 (0.70–0.71)	0.001	0.68 (0.67–0.69)	0.001	0.31 (0.30–0.32)	0.001	0.53 (0.50–0.55)	0.001	0.67 (0.67–0.68)	0.001	0.49 (0.48–0.49)	0.001
Medical insurance												
Insured	Reference		Reference		Reference		Reference		Reference		Reference	
Uninsured	0.85 (0.83–0.87)	0.001	1.06 (1.03–1.10)	0.001	0.72 (0.67–0.77)	0.001	1.44 (1.30–1.59)	0.001	0.92 (0.89–0.94)	0.001	0.90 (0.87–0.94)	0.001

Note: [a] Adjusted for all variables listed in the table. OR, odds ratio; CI, confidence interval.

[b] Single: unmarried, divorced or widowed.

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Table 3. The pattern of multimorbidity based on Mining Association Rules of Apriori algorithm in community-dwelling elderly people in Guangzhou, China

Left hand side	Right hand side	Support (%)	Confidence (%)	*lift*
Diabetes[a]	Hypertension	12.495	17.579	1.404
Coronary heart disease [a]	Hypertension	4.377	5.718	1.512
Coronary heart disease [a]	Diabetes	1.615	5.718	1.606
Coronary heart disease, Hypertension [b]	Diabetes	1.385	4.377	1.799

Note: [a] The results of association rules for relationship between chronic diseases with 1 left-hand-side.

[b] The results of association rules for relationship between chronic diseases with 2 left-hand-side.
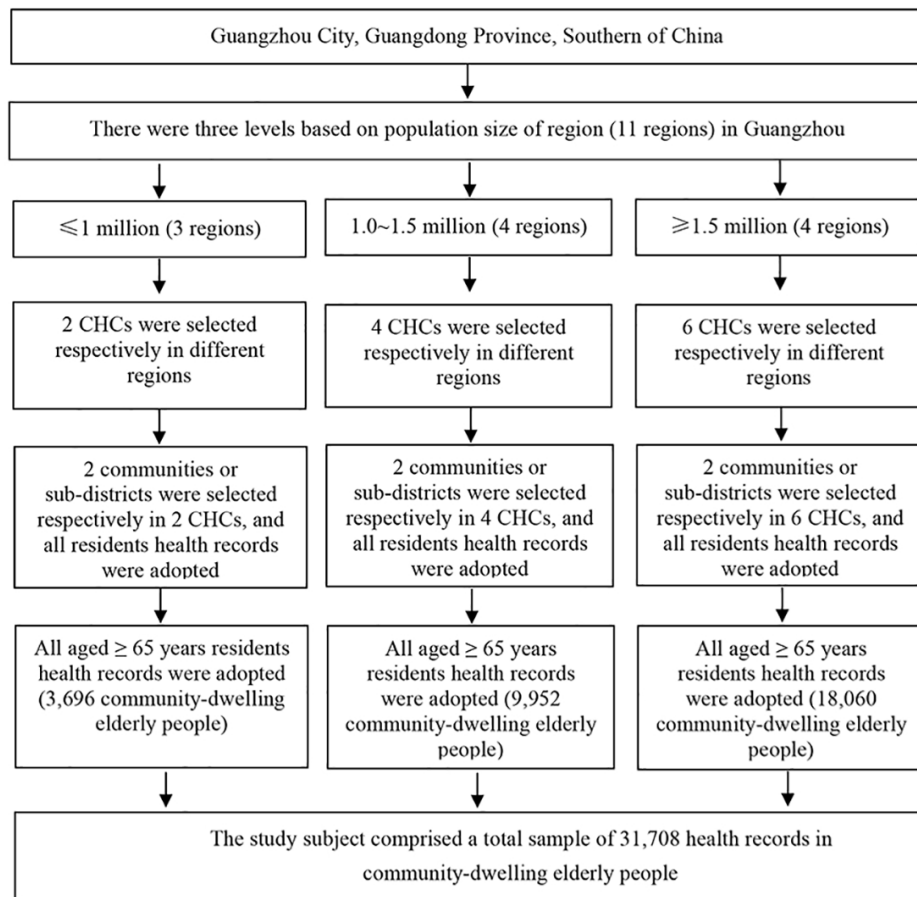
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│           Guangzhou City, Guangdong Province, Southern of China   │
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│ There were three levels based on population size of region        │
│ (11 regions) in Guangzhou                                         │
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│ ≤1 million       │  │ 1.0~1.5 million  │  │ ≥1.5 million     │
│ (3 regions)      │  │ (4 regions)      │  │ (4 regions)      │
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│ 2 CHCs were      │  │ 4 CHCs were      │  │ 6 CHCs were      │
│ selected         │  │ selected         │  │ selected         │
│ respectively in  │  │ respectively in  │  │ respectively in  │
│ different regions │  │ different regions │  │ different regions │
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│ 2 communities or │  │ 2 communities or │  │ 2 communities or │
│ sub-districts    │  │ sub-districts    │  │ sub-districts    │
│ were selected    │  │ were selected    │  │ were selected    │
│ respectively in  │  │ respectively in  │  │ respectively in  │
│ 2 CHCs, and all  │  │ 4 CHCs, and all  │  │ 6 CHCs, and all  │
│ residents health │  │ residents health │  │ residents health │
│ records were     │  │ records were     │  │ records were     │
│ adopted          │  │ adopted          │  │ adopted          │
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│ All aged ≥ 65    │  │ All aged ≥ 65    │  │ All aged ≥ 65    │
│ years residents  │  │ years residents  │  │ years residents  │
│ health records   │  │ health records   │  │ health records   │
│ were adopted     │  │ were adopted     │  │ were adopted     │
│ (3,696 community-│  │ (9,952 community-│  │ (18,060          │
│ dwelling elderly │  │ dwelling elderly │  │ community-       │
│ people)          │  │ people)          │  │ dwelling elderly │
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┌─────────────────────────────────────────────────────────────────┐
│ The study subject comprised a total sample of 31,708 health       │
│ records in community-dwelling elderly people                      │
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Figure 1: Sampling framework in this study in Guangzhou, China
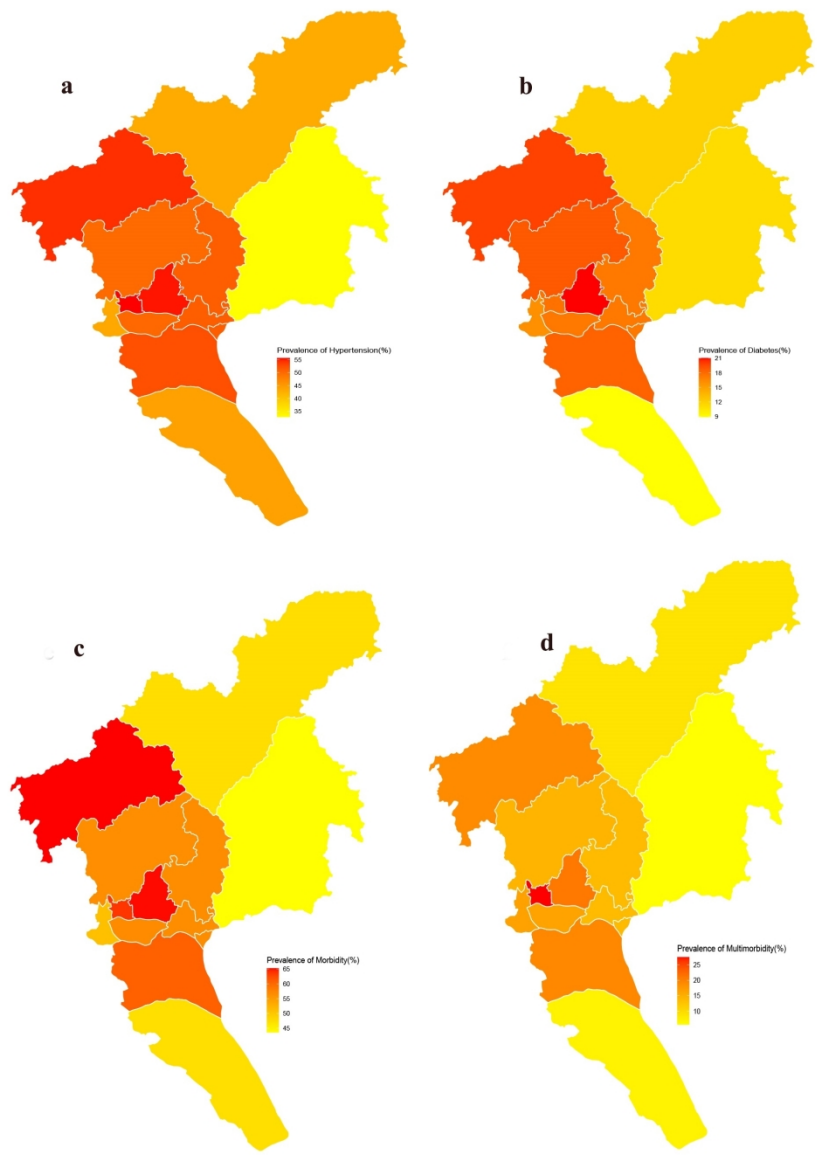Note: CHCs: Community health centers.

Figure 2: Prevalence of chronic conditions by region in community-dwelling elderly people in Guangzhou, China
Note: a Prevalence of Hypertension.
b Prevalence of Diabetes.
c Prevalence of Morbidity.
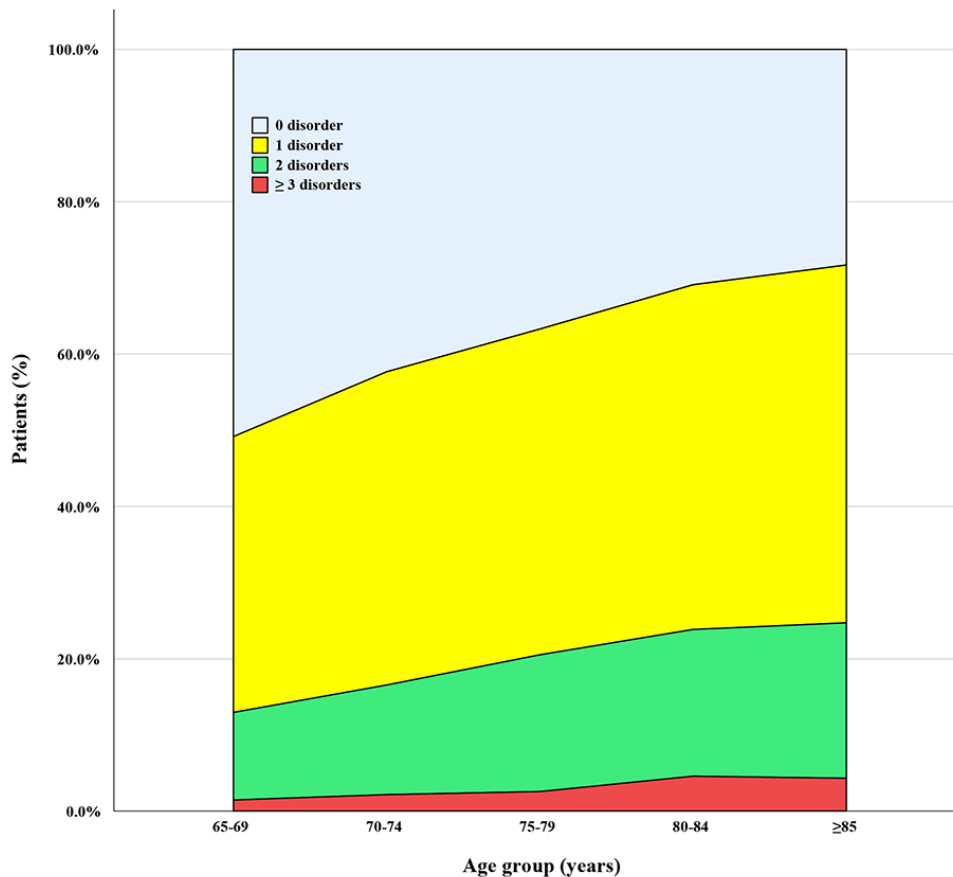d Prevalence of Multimorbidity.

180x231mm (300 x 300 DPI)

Figure 3: Number of chronic conditions by age group in community-dwelling elderly people in Guangzhou, China
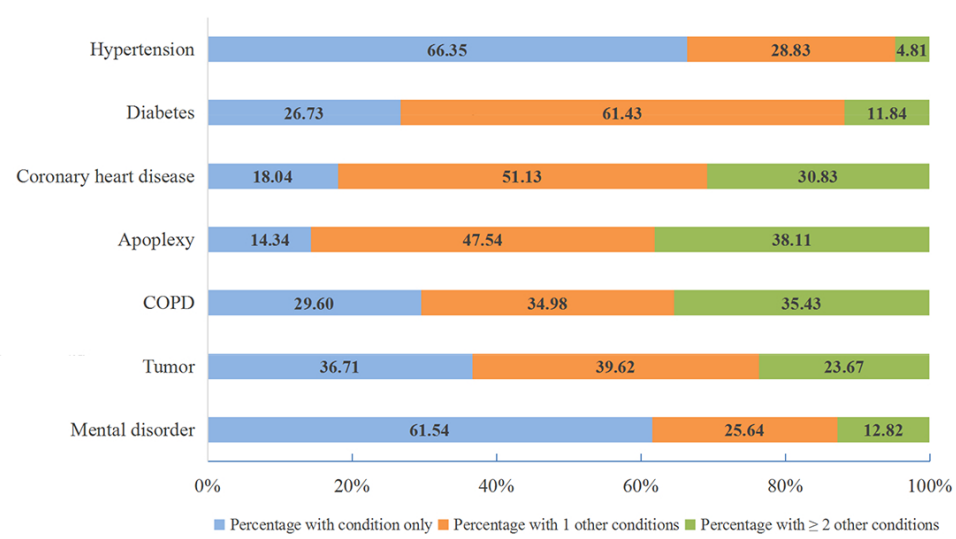
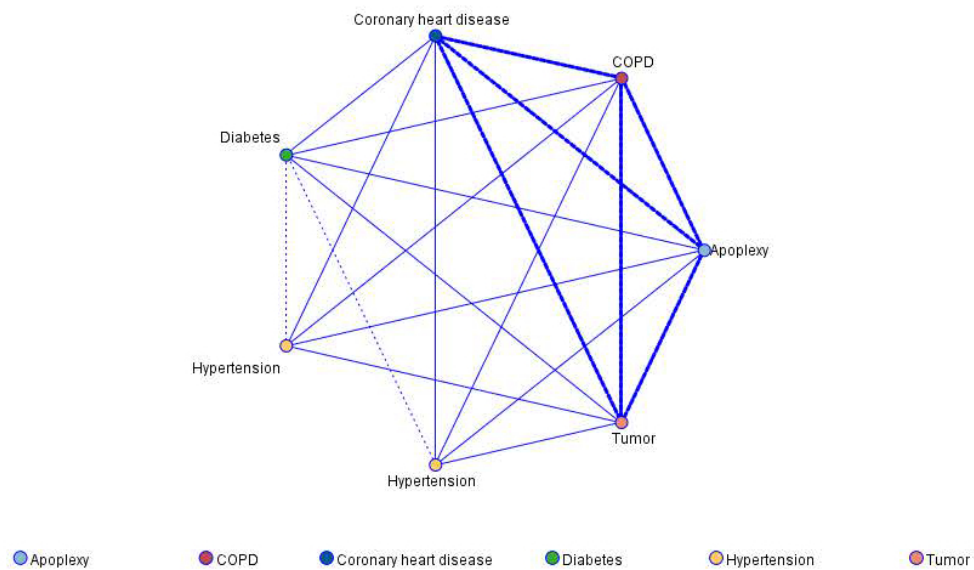Figure 4. Number of chronic conditions in community-dwelling elderly people in Guangzhou, China

Figure 5. Web diagram of comorbidity in community-dwelling elderly people in Guangzhou, China

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page Numbers
Title and abstract	1	(*a*) Prevalence and patterns of multimorbidity in chronic diseases in Guangzhou, China: a data mining study in the residents' health records system among 31,708 community-dwelling elderly people	1
		(*b*) The prevalence of morbidity was 54.99% (95%CI: 40.11%-60.11%) and the multimorbidity was 15.17% (95%CI: 12.38%-18.44%) among 31,708 community-dwelling elderly people in Guangzhou, China. Elderly, female, higher education level, being single, living in urban areas and having medical insurance were more likely to have chronic diseases and multimorbidity. Our data included seven prevalent chronic conditions, most of which accompanied with one or more other chronic diseases. Our study also reveals several patterns of multimorbidity among elderly residents in Guangzhou, including coexistence of hypertension and diabetes, hypertension and coronary heart disease, diabetes and coronary heart disease, diabetes, coronary heart disease and hypertension. A high prevalence of morbidity and a relatively low multimorbidity of chronic diseases exist in elderly people. Data mining of residents' health records will help for strengthening the management of residents' health records in community health service centers of Guangzhou, China.	3~4
Introduction			**5~7**
Background/rationale	2	Multimorbidity led to serious consequences for elderly people. Data mining of electronic health records was a novel way to understand disease morbidity and multimorbidity among elderly residents. However, studies with application of electronic health records in community health service centers are limited in China.	5~6
Objectives	3	This study aimed to estimated the prevalence of chronic diseases, multimorbidity and patterns of multimorbidity in Guangzhou, China.	7
Methods			**7~8**
Study design	4	A cross-sectional study	7
Setting	5	This study conducted in Guangzhou City, China. A total of 31,708 community-dwelling older adults (aged ≥65 years) were recruited by multistage, stratified random sampling.	7
Participants	6	Cross-sectional study 1) Resident of Guangzhou City, China; 2) aged 65 years or older; 3) established residents' health records in community health service centers.	7
Variables	7	Data on age, gender, marital status, educational level, living areas, medical insurance, and the past medical history were collected in residents' health records in this study.	7
Data sources/ measurement	8*	Prevalence of chronic diseases, multimorbidity; Patterns of multimorbidity	7
Bias	9	Selection bias and recall bias.	7
Study size	10	A total of 31,708 community-dwelling older adults (aged ≥ 65 years) were recruited by multistage, stratified random sampling.	7
Quantitative variables	11	Prevalence of chronic diseases	7

| Statistical methods | 12 | Statistical analysis was performed using R and SPSS 21.0 (SPSS Inc., Chicago, IL). The Chi-square, t-test and one-way analysis of variance (ANOVA), were used to assess the differences in socio-demographic characteristics between subjects. Binary logistic regression analysis was conducted to examine factors associated with chronic diseases and multimorbidity, and a forward stepwise selection strategy was adopted when the regression models performed. To increase the representativeness of the study population, all statistics were calculated by using base weights adjustment (population weight and post-stratification sample weights). The complex samples module in SPSS 21.0 was adopted to account for the multistage sample design. Geographic heat map of chronic diseases were draw by R 3.2.1 program. The association rule mining analysis was used to explore the correlations and patterns of multimorbidity between chronic diseases among community-dwelling elderly people. P < 0.05 was considered statistically significant in the present study. | 8 |

Results			**9~10**
Participants	13*	A total of 31,708 community-dwelling older adults (aged ⩾ 65 years) were recruited by multistage, stratified random sampling.	9
Descriptive data	14*	In this study, we found that the prevalence were 54.99% for morbidity and 15.17% for multimorbidity, and which were associated with several factors among 31,708 community-dwelling elderly people.	9
Outcome data	15*	Prevalence of chronic diseases, multimorbidity; Patterns of multimorbidity	9
Main results	16	Elderly, female, higher education level, being single, living in urban areas and having medical insurance were more likely to have chronic diseases and multimorbidity. Our data included seven prevalent chronic conditions, most of which accompanied with one or more other chronic diseases. Our study also reveals several patterns of multimorbidity among elderly residents in Guangzhou, including coexistence of hypertension and diabetes, hypertension and coronary heart disease, diabetes and coronary heart disease, diabetes, coronary heart disease and hypertension.	9~10
Other analyses	17	No.	-
Discussion			**10~15**
Key results	18	A high prevalence of morbidity and a relatively low multimorbidity of chronic diseases exist in elderly people. Data mining of residents' health records will help for strengthening the management of residents' health records in community health service centers of Guangzhou, China.	10
Limitations	19	Some limitations were included in this study. Firstly, although the sample size was enough, the number of chronic diseases were small in this study. Secondly, the prevalence of major chronic diseases was consisted with results of the national health survey, but some chronic diseases were lower than other studies, such as apoplexy, COPD, and tumor. Those may lead to a low prevalence of multimorbidity. At the same time, the residents' health records in communities were based on self-reporting; thus, the selection bias and recall bias were introduced. Therefore, a larger and prospective cohort design based on residents'	14

		health records to infer the causal relationship is needed in future research.	
Interpretation	20	Some strengths were also included in present study. There are few studies on data mining of residents' health records in community health service centers in China. In the present study, a multistage, stratified random sampling method was selected, and 31,708 elderly people were adopted, which can explore representatively the current status and quality of residents' health records of Guangzhou, southern of China. And the results will help for strengthening the management of residents' health records in community health service centers of Guangzhou, China.	11
Generalisability	21	These findings may provide useful information for multifactorial interventions of multimorbidity and strengthening the management of residents' health records in community health service centers of Guangzhou, China.	15
Other information			**16**
Funding	22	This study was supported by National Natural Science Foundation of China (72072191); The Key Project of Medicine Discipline of Guangzhou (No.2021-2023-12); Basic Research Project of Key Laboratory of Guangzhou (No.202102100001), and The Science Technology Project of Guangzhou Municipal Health Commission (20191A011054, 20201A011058, 20201A011064).	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.