Multimorbidity Patterns among Rural Adults with Type-2 Diabetes Mellitus: A Cross-Sectional Study in Kerala, India

Abstract

Objectives: The study evaluated the prevalence and pattern of multi-morbidity among rural adults with type-2 diabetes mellitus and explored the factors associated with multi-morbidity among 400 adult diabetic patients from rural areas of Thiruvananthapuram district in the Kerala state of India.

Materials and Methods: The presence of multi-morbidity was assessed using a semi-structured interview schedule based on the physician’s confirmation. The reported chronic diseases were classified as concordant (conditions with a similar pathophysiology risk profile as diabetes) and discordant (conditions whose treatments are not directly related to the pathogenesis for diabetes) co-morbidity. Multivariate analysis was done to find the factors associated with multi-morbidity.

Results: Prevalence of multi-morbidity among diabetic patients was 74% (95% Confidence Interval (CI): 69-77), around 66% reported at least one concordant co-morbidity, 30% reported at least one discordant co-morbidity and 21% reported both concordant and discordant co-morbidity with diabetes. Hypertension (59%) was the most frequent co-morbidity. Older adults (above 60 years of age) [Odds Ratio (OR):3.42, 95% CI:1.97-5.94] and women (OR:2.16, CI:1.13-3.51) were more likely to have multi-morbidity compared to their counterparts. Those using insulin and/or oral medication were more likely to have multi-morbidity compared to those using oral medication only (OR: 2.19, CI: 1.07-4.09).

Conclusion: Multi-morbidity among diabetic patients needs to be addressed by a comprehensive and integrated approach rather than a diabetes specific approach.

Keywords: Co-morbidity, India, Kerala, multi-morbidity, type 2 diabetes

Introduction

Diabetes is one of the largest global public health problems worldwide, and there were estimated 463 million diabetes patients in 2019, which is expected to increase to 700 million in 2045. The global burden of disease study reported that diabetes is the ninth leading cause of global mortality. Overall, around 5 million deaths were attributable to diabetes. India has the second-largest number of people with diabetes (77 million) after China (116.4 million). Kerala state has reported the highest prevalence of diabetes and a higher morbidity rate in India.

Multimorbidity in diabetes patients created complex effects on the overall health as well as their self-management activities and medication adherence, reduced quality of life, negative health outcomes, and higher health-care utilization. Multimorbidity was reported by 50% of adult diabetes patients, and this increased as age increased. The original utilization and categorization of diabetes multimorbidity as concordant comorbidity and discordant comorbidity was reported by Piette.

A few studies identified the effect of comorbid conditions in diabetes patients in India. One such study from urban primary health-care centers in Odisha state of India reported a multimorbidity prevalence of 84% among diabetes patients. This study, we examined the prevalence, pattern, and factors associated with multimorbidity among rural adults with Type 2 diabetes mellitus in Kerala.

Methods

A community-based cross-sectional survey was done using a multistage random sampling method. The study was conducted in Thiruvananthapuram district of the Indian state of Kerala, which is the most advanced state regarding epidemiological and demographic transition. Among the six taluks (administrative divisions below the district) in the district,

How to cite this article: Soji DJ, Lordson J, Mini GK. Multimorbidity patterns among rural adults with Type-2 diabetes mellitus: A cross-sectional study in Kerala, India. WHO South-East Asia J Public Health 2021;10:32-6.
one was selected randomly. In the selected taluk, out of the eleven grama panchayats (GP) (lowest administrative division in rural areas), two GPs were selected randomly. From each GP, we randomly selected four wards (the smallest geographic unit of the GP). From each ward, fifty subjects were selected. The survey was done after identifying a central location in the selected ward and then the first house was identified and using a clockwise direction, all houses were visited till 50 diabetes patients were identified, similar to the methodology by the World Health Organization expanded program on immunization cluster sampling technique.[14]

Based on the previously reported quality of life (38%) among hospital-based diabetes patients, we estimated the sample size as 185 with a precision of seven. Since the sample selection procedure was cluster sampling, a design effect of 2 was used, and the estimated final sample size was 370, which was rounded off to 400.

A trained public health nurse (SDJ) conducted all the data collection with assistance from a public health scholar. Using a semi-structured interview schedule, we collected details of chronic diseases diagnosed by a physician or a health-care provider and also gathered sociodemographic details and diabetes-related compliances.

Definitions

Diabetic patient was defined as adult with diabetes for more than 6 months and under treatment for diabetes. Multimorbidity was defined as the coexistence of at least one comorbidity with diabetes. We divided the reported chronic diseases into two: concordant and discordant comorbidity.[7] Concordant comorbidity was defined as conditions with a similar pathophysiologic risk profile and discordant comorbidity as conditions whose treatments are not directly related to the pathogenesis for diabetes. From the list of reported morbidities, we included hypertension, dyslipidemia, cardiovascular disease, chronic kidney disease, and diseases of the brain or nervous system as concordant comorbidity and arthritis, thyroid, cancer, kidney stone, multiple cirrhosis, hernia, filariasis, and tuberculosis as discordant comorbidity.

Socioeconomic status (SES) was assessed based on the color of the ration card (official document given by the state government and the color of the card is based on the SES). There are four different colored ration cards. We reported low SES as pink or yellow card, middle SES for blue, and high SES for white cardholders. We divided the whole sample into three groups based on the disease prevalence; diabetes only, diabetes with at least one concordant co-morbidity, and diabetes with at least one discordant co-morbidity.

The study got ethical clearance from the host Institute Ethics Committee. Written informed consent was obtained from all the participants.

Statistical analysis

Data analysis was done using SPSS version 21.0 ((IBM SPSS Statistics for Windows, Version 21.0.Armonk, NY: IBM Corp). Descriptive statistics was used to summarize socio-demographic characteristics and medication use. Association between categorical variables was compared using the Chi-square test. Multivariate analysis using multiple logistic regression model was used to find the determinants of multimorbidity among diabetes patients. Adjusted odds ratios (OR) were presented with a 95% confidence interval (CI). In all cases, \( P \leq 0.05 \) was considered statistically significant.

Results

Background characteristics

The mean/median age of the participants was 58 years (standard deviation: 11.5) ranging from 29 to 93 years, 51% were men. Forty-five percentage of the participants were older adults (≥60 years), 82% currently married, and 4% had no formal education, and 83% had <10 years of schooling. More than half of them (55%) were employed at the time of the survey. Thirty-five percentage of the participants belonged to low SES, 26% middle, and 39% high SES, and 46% had a family history of diabetes. The mean duration of diabetes was 9 years, and 41% had diabetes for more than 10 years.

The majority of them (98%) were on allopathic treatment and 2% used Ayurvedic medicine for diabetes. There were three participants using homeopathic medicine at the time of the survey, along with allopathic medicine. Fourteen participants used Ayurvedic medicine; half of them used it with allopathic medicine. Around 79% reported exclusive use of oral medication, 4% exclusive use of insulin, and 17% reported to use both.

Disease-related complications

Nearly half (51%) of the participants had any of the following diabetes-related complications; retinopathy (50%), nephropathy (1.8%), 1.5% had diabetic foot ulcers (1.5%), and neuropathy (0.8%).

Prevalence and pattern

Overall prevalence of multimorbidity was 74% (95% CI: 0.69–0.77). Around 66% reported at least one concordant comorbidity and 30% reported at least one discordant comorbidity. More than one-fourth (26%) of the participants reported diabetes only and 21% reported both concordant and discordant comorbidity with diabetes, 45% reported discordant comorbidity only, and 8% reported discordant comorbidity only.

The comorbidities reported were hypertension (59%), dyslipidemia (37%), arthritis (20%), cardiovascular diseases (9%), thyroid disease (9%), chronic kidney disease (2%), diseases of brain/nervous system (2%), and
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two persons each had breast cancer and kidney stone and one person each had an abdominal cyst, filariasis, hernia, multiple cirsosis, and tuberculosis.

Age- and sex-wise pattern of multimorbidity is presented in Figure 1. Multimorbidity was higher among women than men in both age groups. The same trend was seen in concordant comorbidity. Among older adults (age ≥60 years), there was no difference between the prevalence of discordant comorbidity among men and women.

**Determinants**

Bivariate analysis of background characteristics with different multimorbidity pattern is presented in Table 1. Multimorbidity was significantly higher in older adults, women, and among those who were using insulin or oral medication. The presence of concordant comorbidity with diabetes was also significantly higher among older adults compared to younger participants. A higher proportion of concordant comorbidity was found in those who were having diabetes for 10 or more years compared to those who were having <10 years. Furthermore, concordant comorbidity was higher among those who were using insulin and/or oral medication compared to those who were using oral medication only.

Multivariate logistic regression analysis results showed that older adults (OR: 3.42, 95% CI: 1.97–5.94) and women (OR: 2.16, CI: 1.13–3.51) were more likely to have multimorbidity compared to their counterparts after adjusted for education, SES, family history of diabetes, and duration of diabetes. Those who were using insulin and/or oral medication were more likely to have multimorbidity compared to those who were using oral medication only (OR: 2.19, CI: 1.07–4.09).

**Discussion**

Close to three-fourth of the participants had multimorbidity, which is lower than that reported among diabetes patients from Odisha state of India\[8\] and also from other countries.\[8,12,16\] Our findings on the proportion of at least one concordant comorbidity (74%) and at least one discordant comorbidity (66%) was higher than that reported among diabetes patients in the United States of America (41% and 48%, respectively).\[16\] The most common comorbidity among diabetes patients was hypertension as reported by several earlier studies.\[8,12,16\]

Similar to that reported from previous studies,\[8,12,16\] our study found that multimorbidity among diabetes patients was higher among the elderly compared to their younger counterparts. Our results show that, compared to those who were using oral medication only, those who were using combination therapy or insulin only reported more co-morbidities with diabetes. This shows the necessity of considering the treatment type for managing multimorbidity among diabetes patients. On the other hand, the association of the type of drug use with the presence of comorbidity is also to be considered. It should be noted that current diabetes management does not appropriately consider individuals with multiple comorbidities.\[17\]

The study showed a significant association between gender and multimorbidity associated with diabetes. Women reported more multimorbidity in general,\[18\] as well as among the diabetes population.\[16\] This might also be due to the prevalent gender discrimination in health-care access for women in India.\[19\] The possibility of a higher tendency of women to share their health conditions\[20\] is also to be considered. Earlier studies reported a significant association between low SES and multimorbidity,\[18\] but no such association was seen in the present study.

To our knowledge, this is the first comprehensive study on multimorbidity among diabetes patients in Kerala in the context of concordant and discordant comorbidity. A major strength of our study is that all interviews were conducted by a single investigator at the participants’ households. One of the limitations of the study is the classification of multimorbidities. We only considered the presence of comorbidity and not the severity of the disease, which might have had a direct effect on diabetes management. However, in the context of the unavailability of related literature from the state, our findings will be an evidence-based foundation for future longitudinal researches on diabetes and multimorbidity. Another limitation was the possibility of recall bias resulting from self-reports. This might have been a reason for not reporting some of the major comorbidities of diabetes.

**Conclusion**

Our findings highlighted a high prevalence of comorbidities among diabetes patients, which need to be addressed by disease management programs. Future research into areas related to the severity in the context of multimorbidity and comorbidity management would help to better understand
Table 1: Pattern of multi-morbidity by background characteristics: Results of bivariate analysis

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total, n (%)</th>
<th>With no comorbidity, n (%)</th>
<th>With any comorbidity (multi-morbidity), n (%)</th>
<th>With at least one concordant comorbidity, n (%)</th>
<th>With at least one discordant comorbidity, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age group (years)</td>
<td></td>
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<tr>
<td>&lt;60</td>
<td>222 (55.5)</td>
<td>78 (35.1)</td>
<td>144 (64.9)</td>
<td>120 (50.4)</td>
<td>52 (23.4)</td>
</tr>
<tr>
<td>≥60</td>
<td>178 (44.5)</td>
<td>27 (15.2)</td>
<td>151 (84.8)</td>
<td>142 (79.8)</td>
<td>66 (37.1)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>202 (50.5)</td>
<td>64 (31.7)</td>
<td>138 (68.3)</td>
<td>131 (64.9)</td>
<td>46 (22.8)</td>
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<tr>
<td>Women</td>
<td>198 (49.5)</td>
<td>41 (20.7)</td>
<td>157 (79.3)</td>
<td>131 (66.2)</td>
<td>72 (36.4)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
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<tr>
<td>No formal education/&lt;10 years of schooling</td>
<td>259 (64.8)</td>
<td>66 (25.5)</td>
<td>193 (74.5)</td>
<td>167 (64.5)</td>
<td>92 (35.5)</td>
</tr>
<tr>
<td>≥10 years of schooling</td>
<td>141 (35.3)</td>
<td>39 (27.7)</td>
<td>102 (72.3)</td>
<td>95 (67.4)</td>
<td>26 (18.4)</td>
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<td>SES</td>
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<tr>
<td>Low</td>
<td>142 (35.5)</td>
<td>32 (22.5)</td>
<td>110 (77.5)</td>
<td>97 (68.3)</td>
<td>44 (31.0)</td>
</tr>
<tr>
<td>Medium</td>
<td>103 (25.8)</td>
<td>27 (26.2)</td>
<td>76 (73.8)</td>
<td>68 (66.0)</td>
<td>31 (30.1)</td>
</tr>
<tr>
<td>High</td>
<td>155 (38.8)</td>
<td>46 (29.7)</td>
<td>109 (70.3)</td>
<td>97 (62.6)</td>
<td>43 (27.7)</td>
</tr>
<tr>
<td>Family history of DM</td>
<td></td>
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</tr>
<tr>
<td>Yes</td>
<td>184 (46.0)</td>
<td>47 (25.5)</td>
<td>137 (74.5)</td>
<td>122 (66.3)</td>
<td>60 (32.6)</td>
</tr>
<tr>
<td>No</td>
<td>216 (54.0)</td>
<td>58 (26.9)</td>
<td>158 (73.1)</td>
<td>140 (64.8)</td>
<td>58 (26.9)</td>
</tr>
<tr>
<td>Duration of diabetes (years)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>&lt;10</td>
<td>235 (58.8)</td>
<td>68 (28.9)</td>
<td>167 (71.1)</td>
<td>144 (61.3)</td>
<td>58 (24.7)</td>
</tr>
<tr>
<td>≥10</td>
<td>165 (41.2)</td>
<td>37 (22.4)</td>
<td>128 (77.6)</td>
<td>118 (71.5)</td>
<td>60 (36.4)</td>
</tr>
<tr>
<td>Diabetes medication</td>
<td></td>
<td></td>
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<tr>
<td>Oral medication only</td>
<td>315 (78.8)</td>
<td>91 (28.9)</td>
<td>224 (71.1)</td>
<td>198 (62.9)</td>
<td>89 (28.3)</td>
</tr>
<tr>
<td>Insulin and/or oral medication</td>
<td>85 (21.2)</td>
<td>14 (16.5)</td>
<td>71 (83.5)</td>
<td>64 (75.3)</td>
<td>29 (34.1)</td>
</tr>
</tbody>
</table>

*P<0.05, percentages present are row percentage. SES: Socioeconomic status, DM: Diabetes mellitus

the burden of multimorbidity among diabetes patients in low- and middle-income countries like India. The need for a comprehensive, integrated care for diabetes with multimorbidity is warranted in the state considering the risk of current fragmented health care for diabetes.

Acknowledgment

This study was conducted as a part of the Master of Public Health (MPH) dissertation work of the first author (SDJ) under Kerala University of Health Sciences (KUHS) at the Global Institute of Public Health (GIPH), Thiruvananthapuram, Kerala. The authors would like to thank all the faculty members of GIPH who provided technical support at various stages of this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References