

Prevalence of Multimorbidity and Its Associated Factors among Residents in the Coastal Region of Southern Karnataka, India: A Descriptive Analysis¹

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Abstract Background: India is currently undergoing a rapid transition with respect to demography and lifestyle which has led to a change in magnitude and pattern of diseases across the country. There is an increase in the prevalence of non-communicable diseases (NCDs) with an increase in the prevalence of multimorbidity due to ageing population and longevity. **Objective:** The objective of our study was to estimate the prevalence of multimorbidity and its determinants among the rural and semi-urban population in a coastal region of Karnataka. **Methods:** A retrospective analysis of the health and socio-demographic data available from the five peripheral health centres attached to a medical college was carried out. A total of 31,817 study participants above the age of 18 years were included in the study. Univariable and multivariable logistic regression analysis was done to check the association between socio-demographic characteristics and multimorbidity with $p < 0.05$ being taken as statistically significant. **Result:** Out of the 31,817 study participants, 6.4% had multimorbidity. People ≥ 60 years were at sixty

times higher odds of having multimorbidity as compared to people < 60 years which was statistically significant. Multimorbidity were significantly higher among people belonging to minority religions [(Muslim: adjusted odds ratio (AOR)=1.51; 95% confidence interval (CI)=1.24-1.83 and Christian: AOR=1.34; 95% CI=1.09-1.64)], those with 1-10 years of schooling (AOR=1.22; 95% CI=1.06-1.41), those who were currently unemployed/homemaker [(currently unemployed: AOR=2.14; 95% CI=1.88-2.45 and homemaker: AOR=2.21; 95% CI=1.88-2.59)] and residing in semi-urban area (AOR=1.28; 95% CI=1.15-1.44). **Conclusions:** Considering the higher proportion of multimorbidity among the aged and the vulnerable group there is an urgent need to devise screening guidelines and targeted interventions for chronic conditions among this specific population.

Keywords Multimorbidity, Non-Communicable Diseases, Chronic Diseases, Risk Factors

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1. Introduction

India is going through a rapid transition with respect to demography and lifestyle. This has indirectly led to a change in the magnitude and pattern of diseases across the country. While communicable diseases are on the decline, there is an undoubted rise in non-communicable diseases (NCDs). About 60% of deaths are caused by NCDs in India. More than half of the deaths due to NCDs are pre-mature in nature and affect the productive population [1]. It has been predicted that, globally the proportion of people aged above 60 years is going to increase by three-fold by 2050. The life expectancy has increased tremendously over the past few decades due to improved health care [2]. This has a major impact on health, economy and social sectors of the country.

Multimorbidity includes the presence of two or more chronic health conditions in a single individual. Several studies have shown that the prevalence of multimorbidity increases substantially with age [3]. People living in the most deprived areas are more likely to suffer from multimorbidity than their counterparts living in the least deprived areas. In most of the Western studies, multimorbidity has been reported to be higher among women and those from poor socio-economic backgrounds [4]. However, studies from developing countries like India, have reported multimorbidity to be more prevalent among the wealthier population [5]. The coastal region of Udupi district is unique in its demographic and lifestyle parameters. The literacy status and health indices in the region are comparable to that of a developed nation [6]. However, there are limited studies from this region that have looked into the prevalence of multimorbidity and the factors influencing it. This study is an attempt to assess the existing data of a defined cohort in the coastal region of Udupi block. With this background, we conducted a study to assess the prevalence and factors associated with multimorbidity in the coastal region of Udupi block.

2. Materials and Methods

We conducted a cross-sectional analysis of data available from five peripheral health centres affiliated with the Department of Community Medicine of a private medical college in Udupi block. These health centres included four rural maternity and child welfare homes of Kadekar, Udyavara, Alevoor, Kaup and one urban health centre at Malpe catering to a population of 40,000 spread across 15 villages. These centres provide primary care services including screening and management of common NCDs in addition to maternal and child health services. Health and socio-demographic details of resident family members in this area are periodically collected by auxiliary nurse midwives (ANMs) of the respective centres in an electronic database. During the home visit, self-reported information on chronic morbidities is collected from household members along with details of investigation and

treatment.

The data set consisted of details of 31,817 people aged 18 years and above with information regarding their diseases from January 2015 to December 2019. The study variables included socio-demographic details such as age, gender, education, marital status, occupation, income and the self-reported morbidity details for adults aged ≥ 18 years. The data was analysed using SPSS version 16 and was summarized as frequencies and percentages. Median and interquartile range (IQR) have been reported for age. Univariable and multivariable logistic regression analysis was done to check the association between socio-demographic characteristics and multimorbidity. Strength of association was expressed in the form of unadjusted and adjusted odds ratio (UOR and AOR) with 95% confidence intervals (CI) and a $p < 0.05$ was taken as statistically significant. The study protocol was approved by the institutional ethics committee (IEC: 201/2020) prior to the initiation of the study.

3. Results

Our study population consisted of 31,817 people of whom 2025 (6.4%) had multimorbidity. The distribution of multimorbidity among five centres was as follows: Malpe [623/7974 (7.8%)], Udyavara [461/6258 (7.4%)], Kaup [396/6804 (5.8%)], Kadekar [326/6325 (5.2%)] and Alevoor [219/4456 (4.9%)]. Among the study population, 13.1% had one morbidity, 5.5% had two, 0.8% had three and 0.01% had four morbidities.

In our study, hypertension was the predominant morbidity seen among 15.7% of the population followed by diabetes mellitus (7.8%). The most common clusters of multimorbidity in our study are diabetes mellitus and hypertension (4.95%) followed by hypertension and cardiovascular diseases (1.37%) as shown in Table 1.

Table 1. Distribution of self-reported chronic diseases among the five health centres (n=31,817)

Chronic diseases	Frequency (%)
Hypertension	4982 (15.7)
Hypertension + diabetes mellitus	1577 (4.9)
Hypertension + cardiovascular diseases	437 (1.4)
Hypertension + stroke	171 (0.5)
Hypertension + cancer	25 (0.1)
Diabetes mellitus	2493 (7.8)
Diabetes mellitus + cardiovascular diseases	259 (0.8)
Diabetes mellitus + stroke	45 (0.14)
Diabetes mellitus + cancer	17 (0.1)
Cardiovascular diseases	684 (2.1)
Cardiovascular diseases + stroke	14 (0.04)
Cardiovascular diseases + cancer	3 (0.01)
Stroke	190 (0.6)
Stroke + cancer	2 (0.01)
Cancer	76 (0.24)

Background Characteristics of the Study Population

The median (IQR) age of the population was 46 (36-59) years and 51.5% were females. Of the total participants 88% were Hindus, 66% were married, 91.7% were literates, 60.4% were employed, 60.2% belonged to a matriarchal family system, 74.9% resided in rural areas and only 0.4% had monthly income \geq 50,000 Rs as depicted in table 2.

There is a linear increase in the prevalence of multimorbidity with age. While the prevalence of multimorbidity was higher among males till the age of 70 years, it was seen that females predominated post the age of 70 years (Figure 1).

On univariable analysis age $>$ 45 years, religion, marital status, literacy, occupation, family system, and area of residence were significantly associated with the multimorbidity. On multivariable analysis higher age [46- $<$ 60 years: AOR=15.57; 95% CI= 11.19-21.67 and \geq 60 years: AOR=60.18; 95% CI= 43.41-83.44], belonging to minority religions [(Muslim: AOR=1.51; 95% CI=1.24-1.83 and Christian: AOR=1.34; 95% CI=1.09-1.64)], those with 1-10 years of schooling (AOR=1.22; 95% CI=1.06-1.41), those who were currently unemployed/homemaker [(currently unemployed: AOR=2.14; 95% CI=1.88-2.45 and homemaker: AOR=2.21; 95% CI=1.88-2.59)] and residing in semi-urban area (AOR=1.28; 95% CI=1.15-1.44) were at higher odds of having multimorbidity. Those who were female (AOR=0.52; 95% CI=0.44-0.60) and unmarried (AOR=0.45; 95% CI=0.32-0.62) were at lower odds of having multimorbidity as depicted in Table 3.

Table 2. Socio-demographic characteristics of the study participants (n=31,817)

Characteristics	Frequency (%)	
Age in years	18-45	15341(48.2)
	46- $<$ 60	8969(28.2)
	\geq 60	7507(23.6)
Gender	Male	15436(48.5)
	Female	16381(51.5)
Religion	Hindu	28001(88.0)
	Muslim	2231(7.0)
	Christian	1585(5.0)
Marital status	Married	21015(66.0)
	Unmarried	6975(22.0)
	Separated/divorced/widow	3827(12.0)
Literacy status	Illiterate	2648(8.3)
	1-10 years of schooling	18359(57.7)
	Above 10 years of schooling	10810(34.0)
Occupation	Employed	19203(60.4)
	Currently unemployed	4017(12.6)
	Home maker	8597(27.0)
Family system	Matriarchal	19138(60.2)
	Patriarchal	12679(39.8)
Area	Rural	23843(74.9)
	Semi-urban	7974(25.1)
Monthly income (INR)	\leq 50000	31678(99.6)
	$>$ 50000	139(0.4)

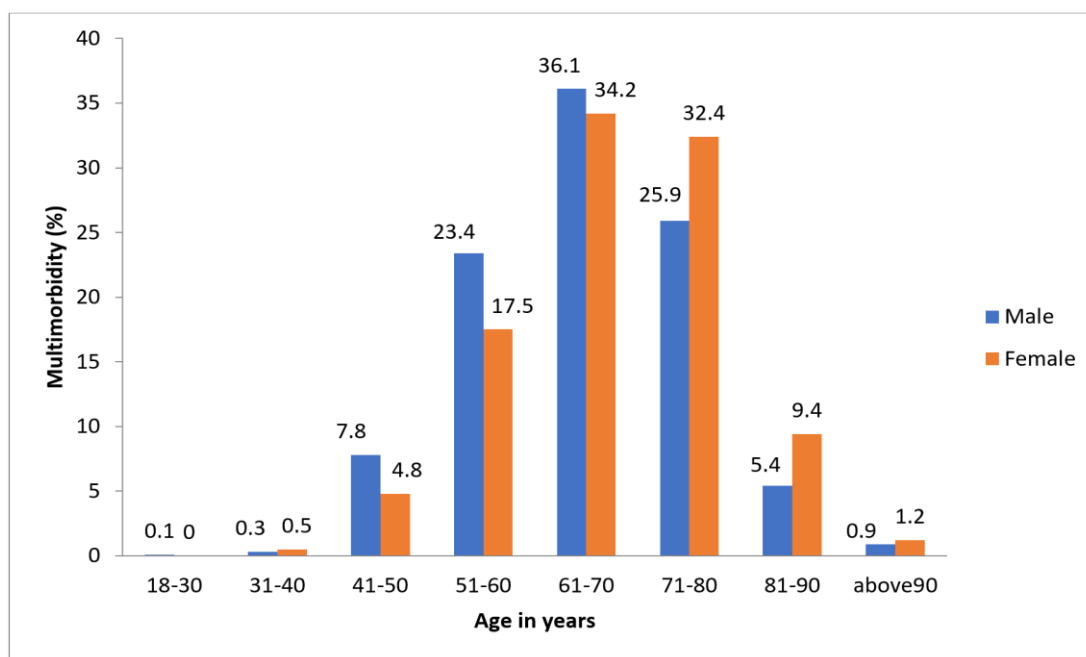


Figure 1. Prevalence of multimorbidity based on age and gender

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Table 3. Determinants of multimorbidity among the study population (n=31,817)

Variable	Frequency of multimorbidity (n, %)		UOR (95% CI)	p value for UOR	AOR (95%CI)	p value for AOR
	Absent	Present				
Gender						
Male	14425(93.5)	1011(6.5)	1		1	
Female	15367(93.8)	1014(6.2)	0.94(0.86-1.03)	0.189	0.52(0.44-0.60)	<0.01
Age in years						
18-45	15300(99.7)	41(0.3)	1		1	
46-<60	8522(95.0)	447(5.0)	19.57(14.20-26.98)	<0.01	15.57(11.19-21.67)	<0.01
≥60	5970(79.5)	1537(20.5)	96.07(70.35-131.19)	<0.01	60.18(43.41-83.44)	<0.01
Religion						
Hindu	26321(94)	1680(6)	1		1	
Muslim	2050(91.9)	181(8.1)	1.38(1.17-1.62)	<0.01	1.51(1.24-1.83)	<0.01
Christian	1421(89.7)	164(10.3)	1.80(1.52-2.14)	<0.01	1.34(1.09-1.64)	<0.01
Marital Status						
Married	19602(93.3)	1413(6.7)	1		1	
Unmarried	6932(99.4)	43(0.6)	0.08(0.06-0.11)	<0.01	0.45(0.32-0.62)	<0.01
Separated/Divorced / Widow	3258(85.1)	569(14.9)	2.42(2.18-2.68)	<0.01	1.10(0.96-1.26)	0.160
Literacy Status						
Illiterate	2311(87.3)	337(12.7)	5.54(4.70-6.54)	<0.01	1.09(0.90-1.32)	0.363
1-10 years of schooling	16948(92.3)	1411(7.7)	3.16(2.77-3.60)	<0.01	1.22(1.06-1.41)	<0.01
Above 10 years of schooling	10533(97.4)	277(2.6)	1		1	
Occupation						
Employed	18465(96.2)	738(3.8)	1		1	
Currently unemployed	3417(85.1)	600(14.9)	4.39(3.92-4.92)	<0.01	2.14(1.88-2.44)	<0.01
Homemaker	7910(92.0)	687(8.0)	2.17(1.95-2.41)	<0.01	2.21(1.88-2.59)	<0.01
Family system						
Matriarchal	17964(93.9)	1174(6.1)	1		1	
Patriarchal	11828(93.3)	851(6.7)	1.10(1.00-1.20)	0.039	0.98(0.88-1.10)	0.751
Area						
Rural	22441(94.1)	1402(5.9)	1		1	
Semi-urban	7351(92.2)	623(7.8)	1.36(1.23-1.49)	<0.01	1.28(1.15-1.44)	<0.01
Monthly income (INR)						
≤50000	29661(93.6)	2017(6.4)	1		1	
>50000	131(94.2)	8(5.8)	0.89(0.43-1.83)	0.768	0.78(0.36-1.67)	0.518

OR: odd's ratio, UOR: unadjusted OR, AOR: adjusted OR, CI: confidence interval

Bold fonts indicate that values are statistically significant

4. Discussion

In this study, we have described the prevalence of multimorbidity and its determinants among the people of the coastal region of Udupi block. NCDs and their related morbidities pose a huge challenge for the health-care system in India, especially in rural settings with limited resources [7].

In our study, 6.4% of the population had multimorbidity which is in concordance with study findings of other Indian studies by Prenissl J et al (7.2%) and Singh K et al (9.4%) [8,9]. Our findings are consistent with previous studies from India that have shown an increasing trend with age and the presence of multiple chronic health conditions in individuals [10]. In a large study from seven Indian states by Mini GK et al, more than 60% of the older adults had at least one NCD and among those with NCDs, 49% had multimorbidity [3]. This suggests that the challenge of managing multiple chronic health conditions is not unique to a particular region but rather a nationwide concern.

Multimorbidity becomes progressively more common with age as reported by several studies [3,4,5,11]. In our study, people aged > 45 years and above had significantly higher odds of having multimorbidity compared to those aged ≤ 45 years and the difference was significant even after adjusting for other variables such as gender, religion, literacy, occupation, family system, area of residence and monthly income. A recent study from India has shown that healthcare services are often under-utilized by older adults due to various reasons including discrimination [12]. In a study by Pati S et al from Odisha, India, the overall age and sex-adjusted prevalence of multimorbidity was 28.3% (95% CI, 24.3-28.6) ranging from 5.8% in patients aged 18 to 29 years to 45% in those aged older than 70 years [13]. Among the studies from Western countries, the prevalence of multimorbidity was reported to be 45% among adults aged ≥65 years from Kosovo, 62% among adults aged ≥65 years from Germany, and 55% among older adults aged ≥77 years from Sweden [14,15,16]. The observed variation in the prevalence of multimorbidity could be due to differences in the study setting, the age of the population included and the source of information regarding morbidity besides others. Among Indian studies highest prevalence of NCDs has been reported from Kerala possibly due to the better access and use of healthcare in this state [3,17].

One of the key findings of this study is the association between socio-demographic factors and multimorbidity. In our study age >45 years, belonging to Muslim/Christian religion, having 1-10 years of schooling, being unemployed/homemaker and residing in semi-urban areas were associated with significantly higher odds of having multimorbidity. People with limited education often have less access to health information, reduced health literacy, and lower socioeconomic status, all of which can contribute to a higher risk of developing chronic diseases. Unemployment can lead to economic stress and reduced access to healthcare, while homemakers may face

challenges in balancing family responsibilities and self-care. Different religious communities may have varying dietary habits, lifestyle choices, and healthcare-seeking behaviours that can contribute to disparities in the prevalence of chronic diseases. The higher risk of multimorbidity in semi-urban areas could be due to differences in lifestyles, access to health care services as well as health-seeking behaviour of the population.

In a study from Odisha, India, older age, female sex, higher education, and high income were associated with significantly higher odds of multimorbidity [13]. The higher prevalence of multimorbidity among males compared to females in this study is an interesting finding, as previous studies from Western countries and India have reported a higher prevalence among females [4,18]. This gender disparity in multimorbidity may be influenced by various factors such as differences in healthcare-seeking behaviour, biological factors, and social determinants of health. Biological differences may also play a role, as some conditions, such as cardiovascular diseases, may manifest differently in males and females. Further research is needed to explore the underlying reasons for this gender difference in the context of the study population. In our study, individuals with lower levels of education had a significantly higher prevalence of multimorbidity. This finding underscores the role of social determinants of health and the need for targeted interventions to address health inequalities and improve access to healthcare services among vulnerable populations.

In our study, hypertension and diabetes were the most common multimorbidity and the findings were similar to other Indian studies [3,19]. Some leading morbidities among the Indian population reported in previous studies include diabetes, chronic lung diseases, arthritis and hypertension [20]. The most common multimorbidity in our study are diabetes mellitus and hypertension (4.95%) followed by hypertension and cardiovascular diseases (1.37%). In the study by Mini GK et al among the elderly with multimorbidity, the most common clusters of multimorbidity were arthritis and hypertension (7.5%), arthritis and cataracts (5.3%) and diabetes and hypertension (4.7%) [3]. In a large study from the rural community in China among people older than 60 years, two patterns of chronic multimorbidity were seen characterized by cardiopulmonary disorders (heart failure, arrhythmia, coronary heart diseases, COPD and asthma), depression, and degenerative disorders (eye problems and hearing disorders), whereas the other pattern was characterized by stroke and metabolic factors (hypertension, diabetes, dyslipidemia and obesity) [21]. The higher prevalence of multimorbidity among older adults can be attributed to the cumulative effect of aging and the increased likelihood of developing multiple chronic conditions over time.

In our study, the prevalence of multimorbidity was higher among participants residing in semi-urban areas when compared to those in rural areas which were similar to other Indian and International studies [8,22].

The findings of our study contribute to the growing body of evidence on the prevalence of multimorbidity and the associated socio-demographic factors in the coastal region of Southern India. This study provides a community-based estimate of multimorbidity among people above 18 years of age in this region. Our study also highlights the higher prevalence of multimorbidity among males, older adults, and individuals from lower literacy levels. These findings emphasize the need for comprehensive healthcare strategies that address the prevention, early detection, and management of chronic diseases among vulnerable populations. However, our findings are limited to the population of coastal Karnataka and cannot be generalised to the whole of India. The morbidity estimates from the study may have been underreported due to the self-reported nature of collected data. The study lacked information on lifestyle factors such as tobacco and alcohol use which is an important determinant of multimorbidity.

5. Conclusions

This retrospective study provides valuable information on multimorbidity among the rural and semi-urban population of a coastal region in India. Multimorbidity was significantly higher among the aged population, belonging to minority religions, those with 1-10 years of schooling, those who were currently unemployed/homemakers and residing in semi-urban areas. These findings underscore the role of social determinants of health and the need for targeted interventions to address health inequalities and improve access to healthcare services among vulnerable populations.

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Conflict of Interest

The authors have no conflicts of interest associated with the material presented in this paper.

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