

## Original Research Article

# A multinomial regression model to determine the factors related to morbidity pattern among the geriatric population of Jammu district, Jammu and Kashmir

V. K. Shivgotra, Himani Nanda\*, Manjeet Kumar

Department of Statistics, University of Jammu, Jammu, Jammu and Kashmir, India

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### \*Correspondence:

Dr. Himani Nanda,

E-mail: [himaniandnanda@gmail.com](mailto:himaniandnanda@gmail.com)

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## ABSTRACT

**Background:** Ageing is progressive phenomenon beginning with conception and ends with death. It is a universal reality characterized by increase in morbidity, multimorbidity, increased health care and social demands. The purpose of this study was to examine patterns in morbidities existing among geriatric population and to identify effect of various socio-demographic variables on number of morbidities prevailing among them.

**Methods:** A cross-sectional study was conducted among geriatric population of Jammu district, Jammu and Kashmir, India by using multi-stage procedure. Descriptive analysis was done by using software IBM SPSS version 25.0. Multinomial regression model was used to examine effect of various socio-demographic variables on number of chronic morbidities prevailing among them.

**Results:** A total of 750 geriatric persons included 392 (52.3%) males and 352 (48.7%) females. Majority of them were suffering from vision problems (51.5%), followed by arthritis (40.7%), hypertension (39.3%), and so on. It was observed that Nagalkerke's R square was 0.331 which showed that there exists weak relationship (33.1%) between the predictors and predicted variable. Our findings reported that gender, marital status, dependency status, socio-economic factors and increasing age were mainly responsible for predicting number of morbidities at various levels among the geriatric population with reference category one morbidity.

**Conclusions:** The findings of this study are important to support policy makers and health care professionals in recognizing individuals at risk that could be integrated into current programs of social, economic and health security of older persons.

**Keywords:** Ageing, Geriatric, Morbidity, Maximum likelihood estimate, Multinomial regression

## INTRODUCTION

Population ageing is a global phenomenon, both in developed and developing countries. In the developing countries, the elderly population is increasing due to demographic transition, with deterioration in their health as a result of rapid modernization and industrialization.<sup>1</sup> Population ageing which has been defined as progressive and generalized impairment of function leading to increased risk of age-related diseases is the result of a process known as demographic transition.<sup>2</sup> This phenomenon involves a shift from high mortality and

fertility to low mortality and fertility, leading to an increase in proportion of geriatric population in total population. Reduction of fertility leads to decline in proportion of young in the total population. Reduction of mortality means longer span of the individual.<sup>3</sup>

Population ageing is one of the most important social transformations of twenty first century, with suggestions for nearly all sectors of society, including labour and financial markets, demands for goods and services such as housing, transportation and social protection, etc. It is defined as human success story, reflecting advancement of public health, medicine, socio-economic development, and

their contribution to control of disease, prevention of injury, and reduction in risk of premature health. The increase in human life span and corresponding decrease in levels of fertility lead to a shift in population aged younger to older ages.

According to world population ageing report 2019, there are around 703 million persons aged 65 years and above. This number is estimated to double to 1.5 billion in 2050. Globally, the share of population aged 65 years or above increased from 6 percent in 1990 to 9 percent in 2019, which is further expected to rise to 16 percent in 2050 in such a way that one in six persons worldwide will be aged 65 years and above. The number of persons aged 80 years and above is projected to triple, from 143 million in 2019 to 426 million in 2050.<sup>4</sup> The Government of India has implemented its first “national policy on older persons” in January, 1999 which defines persons having age 60 years and above as elder. The geriatric population of India forms 8-9% of the total population i.e., there are 106 million geriatric persons in our nation making India the second largest global population of elderly citizens.<sup>5</sup> Population ageing is one of the four major trends that portray today’s global population-population growth, population ageing, urbanization and international migration. Each of these trends will have substantial and lasting impacts on sustainable development in the coming decades.<sup>4</sup> Ageing is characterized by time altered changes in individuals’ biological, physiological and health related capabilities and its implication for consequent changes in individual’s role in economy and society.<sup>6</sup> It is a time of multiple illness and general disability. Also, there are some chronic morbidities like hypertension, diabetes, cardiovascular diseases, arthritis, asthma, cancer, and kidney problems etc which are more frequent in geriatric persons due to accumulation of various known and unknown factors with time. Several researches have been conducted on prevalence of morbidity pattern among the geriatric population. But very few studies identify factors which are responsible for such morbidities. Hence, this study was conducted among geriatric population of Jammu district, Jammu and Kashmir with the objective of identifying various socio-demographic variables which influence number of morbidities prevailing among the geriatric population.

## METHODS

### Study design and participants

A cross-sectional study was conducted among the geriatric population of Jammu district, Jammu and Kashmir during the year 2017-2019. Sample size was calculated by using the formula:

$$n = \frac{Z_{\alpha}^2 pq}{d^2}$$

where we consider 95% CI, the z-value at 5% level of confidence for two tailed test is 1.96, prevalence of

diabetes among the geriatric population is 39.0% in a study conducted by Reshmi et al in Kalaburgi, Karnataka in 2016 with absolute precise margin of error 3.5% and with usual statistical constant ( $\alpha=0.05$ ) and ( $\beta=0.2$ ).<sup>7</sup> The calculated sample size was 746. Hence, we included about 750 geriatric persons in our study.

### Sampling methods and data collection

The sample of geriatric population of Jammu district, Jammu and Kashmir was selected by using multi-stage sampling procedure. In the first stage, various tehsils were selected from Jammu district, Jammu and Kashmir and in the second stage; these tehsils were further subdivided into sub divisions, blocks and villages. Data were collected from geriatric population of Jammu district, Jammu and Kashmir by visiting their homes, old age homes, primary health centres, community health centres, private hospitals and clinics, district hospitals etc. The sample of geriatric households was selected from Jammu district by using simple random sampling technique in which each of these geriatric persons had equal probability of being selected. Geriatric patients visiting OPDs of private clinics and district hospitals were selected by using the technique of systematic sampling where the sampling fraction used varies from time to time.

### Data analysis

Multinomial regression: multinomial logistic regression was used to analyse relationship between a non-metric dependent variable and metric or dichotomous independent variables. Multinomial logistic regression compares multiple groups through a combination of binary logistic regressions. The group comparisons are equivalent to the comparisons for a dummy-coded dependent variable, with the group with lowest or highest numeric score used as the reference group. Multinomial logistic regression was used to model categorical dependent variable with more than two categories. Let us suppose there were ‘m’ categories of the dependent variable, one of which was selected as the reference category. Then the (m-1) logits were generated using the remaining (m-1) categories as equation mentioned below:

$$\ln \frac{(P(Y = i|x_1, x_2, \dots, x_n))}{(P(Y = m|x_1, x_2, \dots, x_n))} = \alpha_i + \beta_{i1}x_1 + \beta_{i2}x_2 + \dots \dots \beta_{in}x_n$$

Where  $i = 1, 2, 3, \dots, m-1$  were dependent variable categories;  $\alpha_i$  was the intercept for category  $i$ ;  $x_1, x_2, \dots, x_n$  were independent variables and  $\beta_{i1}, \beta_{i2}, \dots, \beta_{in}$  were the regression coefficients that correspond to n-number of independent variables defined for each dependent category  $i$ . In our study, multinomial regression models were fitted to examine the influence of socio-economic and demographic factors on the number of morbidities present among the geriatric population. Here, the dependent variable “number of morbidities” was measured on nominal scale and reorganized in five

categories: we have coded '1' for reporting one morbidity, '2' for reporting two morbidities, '3' for reporting three morbidities, '4' for four morbidities and '5' for five or more morbidities respectively. So, following multinomial regression models were estimated to assess number of morbidities by socio-economic and demographic predictors of geriatric population. The mathematical form of the regression models fitted was as follows:

$$Z_i = \log (P_i/P_1) = \alpha_i + \sum_{j=1}^n \beta_{ij} * x_j, i = 2,3,4,5$$

and  $P_1 + P_2 + P_3 + P_4 + P_5 = 1$

Where;  $\alpha_i, i = 2,3,4,5$  were constants,  $\beta_{ij}, i = 2,3,4,5; j = 1,2, \dots, n$ : Multinomial regression coefficient,  $P_1$ : estimated probability of reporting one morbidity,  $P_2$ : estimated probability of reporting two morbidities,  $P_3$ : estimated probability of reporting three morbidities,  $P_4$ : estimated probability of reporting four morbidities,  $P_5$ : estimated probability of reporting five or more morbidities. Here  $P_1$  was the reference category. In this way, we estimated the regression coefficients by fitting and applying the above multinomial regression model. Data analysis was performed by using software SPSS version 25.0. Categorization of predictor variables evidence

available in previous literature suggested that morbidity prevalence among the geriatric persons and their treatment seeking behavior vary substantially by socio-demographic factors. The predictor variables included in above multinomial regression models were BMI, age, gender, area, religion, category, family type, marital status, dependency status, living status and socio-economic status respectively.

## RESULTS

In the present study, we enrolled about 750 study subjects in which 392 (52.3%) were males and 358 (47.7%) were females respectively. More than half of the study subjects included i.e., 508 (67.7%) were having normal weight whereas 215 (28.7%) respondents were overweight and only 27 (3.6%) respondents were obese. Majority of the respondents involved in our study i.e., 268 (35.7%) were in age-group of 60-64 years, followed by 211 (28.1%) respondents in age-group of 65-69 years, 124 (16.5%) respondents in age-group 70-74 years, 65 (8.1%) respondents in age-group of 75-79 years and the remaining 82 (10.9%) respondents were in age-group 80 years and above respectively. Table 1 shows the socio-demographic profile of geriatric population of Jammu district, Jammu and Kashmir.

**Table 1: Socio-demographic profile of the study population.**

| Characteristics              |                                 | Males (%)  | Females (%) | Total (%)   |
|------------------------------|---------------------------------|------------|-------------|-------------|
| <b>Gender</b>                |                                 | 392 (52.3) | 358 (47.7)  | 750 (100.0) |
| <b>BMI</b>                   | Normal weight                   | 305 (77.8) | 203 (56.7)  | 508 (67.7)  |
|                              | Overweight                      | 75 (19.1)  | 140 (39.1)  | 215 (28.7)  |
|                              | Obese                           | 12 (3.1)   | 15 (4.2)    | 27 (3.6)    |
| <b>Age-groups (in years)</b> | 60-64                           | 106 (27.0) | 162 (45.3)  | 268 (35.7)  |
|                              | 65-69                           | 123 (31.4) | 88 (24.6)   | 211 (28.1)  |
|                              | 70-74                           | 70 (17.9)  | 54 (15.1)   | 124 (16.5)  |
|                              | 75-79                           | 42 (10.7)  | 23 (6.4)    | 65 (8.7)    |
|                              | 80 and above                    | 31 (13.0)  | 51 (8.7)    | 82 (10.9)   |
| <b>Area</b>                  | Rural                           | 178 (45.4) | 189 (52.8)  | 367 (48.9)  |
|                              | Urban                           | 214 (54.6) | 169 (47.2)  | 383 (51.1)  |
| <b>Religion</b>              | Sikh                            | 44 (11.2)  | 45 (12.6)   | 89 (11.9)   |
|                              | Muslim                          | 49 (12.5)  | 28 (7.8)    | 77 (10.3)   |
|                              | Hindu                           | 299 (76.3) | 285 (79.6)  | 584 (77.9)  |
| <b>Category</b>              | SC/ST and others                | 77 (19.6)  | 97 (27.1)   | 174 (23.2)  |
|                              | General                         | 315 (80.4) | 261 (72.9)  | 576 (76.8)  |
| <b>Family type</b>           | Joint                           | 137 (34.9) | 116 (32.4)  | 253 (33.7)  |
|                              | Nuclear                         | 255 (65.1) | 242 (67.6)  | 497 (66.3)  |
| <b>Marital status</b>        | Widow/widower                   | 55 (14.0)  | 151 (42.2)  | 206 (27.5)  |
|                              | Married                         | 337 (86.0) | 207 (57.8)  | 544 (72.5)  |
| <b>Dependency status</b>     | Living dependent                | 29 (7.4)   | 333 (93.0)  | 362 (48.3)  |
|                              | Living independent              | 363 (92.6) | 25 (7.0)    | 388 (51.7)  |
| <b>Living status</b>         | Living alone                    | 10 (2.6)   | 8 (2.2)     | 18 (2.4)    |
|                              | Living with relatives           | 10 (2.6)   | 12 (3.4)    | 22 (2.9)    |
|                              | Living with spouse              | 19 (4.8)   | 20 (5.6)    | 39 (5.2)    |
|                              | Living with children and spouse | 353 (90.1) | 318 (88.8)  | 671 (89.5)  |
| <b>Socio-economic status</b> | Upper lower                     | 69 (17.6)  | 85 (23.7)   | 154 (20.5)  |
|                              | Lower middle                    | 150 (38.3) | 134 (37.4)  | 284 (37.9)  |
|                              | Upper middle                    | 105 (26.8) | 109 (30.4)  | 214 (28.5)  |
|                              | Upper                           | 68 (17.3)  | 30 (8.4)    | 98 (13.1)   |

**Table 2: Morbidity pattern among the geriatric population.**

| Diseases                   | Frequency (%) |
|----------------------------|---------------|
| Diabetes                   | 199 (26.5)    |
| Hypertension               | 295 (39.3)    |
| Cardiovascular diseases    | 110 (14.7)    |
| Arthritis                  | 305 (40.7)    |
| Asthma                     | 132 (17.6)    |
| Cancer                     | 82 (10.9)     |
| Kidney diseases            | 46 (6.1)      |
| Anaemia                    | 76 (10.1)     |
| Vision                     | 386 (51.5)    |
| Cataract                   | 225 (30.0)    |
| Hearing impairment         | 82 (10.9)     |
| Gastrointestinal disorders | 286 (38.1)    |
| Insomnia                   | 107 (14.3)    |
| Dementia                   | 64 (8.5)      |
| Body ache                  | 194 (25.9)    |
| Psychological disorders    | 46 (6.1)      |
| COPD                       | 32 (4.3)      |
| Musculoskeletal problems   | 35 (4.7)      |
| Others                     | 214 (28.5)    |

Among 750 geriatric persons included in our study, 383 (51.1%) study subjects belonged to urban areas and the other 367 (48.9%) study subjects belonged to rural areas. Most of these people i.e., 584 (77.9%) belonged to Hindu religion, followed by 89 (11.9%) respondents belonging to Sikh religion whereas the remaining 77 (10.3%) respondents belonging to Muslim religion. Majority of the respondents i.e., 576 (76.8%) belonged to general category whereas the remaining 174 (23.2%) belonged to other categories. 497 (63.3%) geriatric persons were from nuclear families whereas the remaining 253 (33.7%) respondents were from joint families. Nearly two-third i.e., 544 (72.5%) of the study population was married, followed by 206 (27.5%) widow/widowers. Economically, 387 (51.6%) respondents were living independent, followed by 221 (29.5%) who were completely dependent on their spouse or others and the remaining 142 (18.9%) respondents were partially dependent on others.

Nearly half of the geriatric population i.e., 388 (51.7%) people were living independent whereas the remaining 362 (48.3%) respondents were dependent on others respectively. Our study population included 284 (37.9%) respondents who were having lower middle socio-economic status, followed by 214 (28.5%) respondents who belonged to upper middle class, 154 (20.5%) persons belonging to upper lower-class category whereas remaining 98 (13.1%) persons were having the socio-economic status of upper class respectively.

The prevalence of morbidities prevailing among the geriatric population of Jammu district, Jammu and Kashmir is depicted in (Table 2). The most common

morbidity was vision problem (51.5%) followed by arthritis (40.7%), hypertension (39.3%), gastrointestinal disorders (38.1%), cataract (30.0%), diabetes (26.5%), body ache (25.9%), asthma (17.6%), cardiovascular diseases (14.7%), insomnia (14.3%), cancer, hearing impairment and anaemia (10.9%) and so on.

**Table 3: Significance test results for multi-regression analysis.**

| Model          | Model fitting criteria | Likelihood ratio tests |    |       |
|----------------|------------------------|------------------------|----|-------|
|                | -2 Log likelihood      | Chi-square             | df | Sig.  |
| Intercept only | 1634.963               |                        |    |       |
| Final          | 1445.753               | 179.210                | 76 | 0.000 |

The multinomial regression model was used to model relationship between the predictors and the dependent variable “number of morbidities”. The model significance and values of likelihood ratio is depicted in (Table 3). Based on these results, the -2 log likelihood values that the difference between the final and intercept only was 1634.963 and  $p=0.000$  which was significant. It was clearly indicated that model fitted the data.

**Table 4: Goodness of fit.**

|          | Chi-square | df   | Sig.  |
|----------|------------|------|-------|
| Pearson  | 1803.175   | 1696 | 0.065 |
| Deviance | 1223.511   | 1696 | 1.000 |

The goodness of fit test for multinomial regression model. The value of Chi-square statistic was  $\chi^2=1803.175$ ,  $p=0.065>0.05$  which showed that all predictor variables which relate the number of morbidities were independent is depicted in (Table 4).

**Table 5: Pseudo R-square.**

| Variables     | R-square |
|---------------|----------|
| Cox and Snell | 0.315    |
| Nagelkerke    | 0.331    |
| McFadden      | 0.190    |

The Nagelkerke's measure of strength of relationship between dependent variable and predictor variables is shown in Table 5. The results showed a weak relationship (33.1%) between the predictors and predicted variable.

Likelihood ratio tests to determine significance of the predictors of model is shown in (Table 6). Here, each element of model was compared to full model in a way to determine which predictors should be included in the model. It was clearly indicated that the predictors area, marital status, dependency status, socio-economic status (SES) and age contributed significantly to final model as  $p<0.05$  respectively.

**Table 6: Likelihood ratio tests.**

| Effect            | Model fitting criteria             |            | Likelihood ratio tests |       |  |
|-------------------|------------------------------------|------------|------------------------|-------|--|
|                   | -2 Log likelihood of reduced model | Chi-square | df                     | Sig.  |  |
| Intercept         | 1455.753                           | 0.000      | 0                      | -     |  |
| BMI               | 1469.633                           | 13.880     | 8                      | 0.085 |  |
| Gender            | 1464.885                           | 9.133      | 4                      | 0.058 |  |
| Area              | 1460.185                           | 4.432      | 4                      | 0.015 |  |
| Religion          | 1474.699                           | 18.946     | 8                      | 0.351 |  |
| Family type       | 1458.688                           | 2.936      | 4                      | 0.569 |  |
| Marital status    | 1470.419                           | 14.666     | 4                      | 0.005 |  |
| Dependency status | 1466.141                           | 10.388     | 4                      | 0.034 |  |
| SES               | 1469.750                           | 13.997     | 8                      | 0.032 |  |
| Age               | 1512.012                           | 56.259     | 16                     | 0.000 |  |
| Category          | 1457.542                           | 1.789      | 4                      | 0.774 |  |
| Living status     | 1464.726                           | 8.973      | 12                     | 0.705 |  |

**Table 7: Parameter estimate table.**

| Morbidity                                     | Two morbidities versus one |       |        |                    | Three morbidities versus one |       |        |                    |
|-----------------------------------------------|----------------------------|-------|--------|--------------------|------------------------------|-------|--------|--------------------|
|                                               | B                          | Sig.  | Exp(B) | 95% CI for Exp (B) | B                            | Sig.  | Exp(B) | 95% CI for Exp (B) |
| Intercept                                     | -2.208                     | 0.007 |        |                    | 0.664                        | 0.279 |        |                    |
| BMI_normal                                    | 0                          | .     | .      | .                  | 0                            | .     | .      | .                  |
| BMI_overweight                                | 0.286                      | 0.483 | 1.331  | 0.598-2.961        | -0.030                       | 0.929 | 0.970  | 0.500-1.883        |
| BMI_obese                                     | 1.294                      | 0.142 | 3.647  | 0.649-4.048        | 0.066                        | 0.853 | 1.069  | 0.201-3.683        |
| Gender_female                                 | 0                          | .     | .      | .                  | 0                            | .     | .      | .                  |
| Gender_male                                   | 1.909                      | 0.007 | 4.747  | 1.681-5.083        | 0.926                        | 0.089 | 2.523  | 0.869-4.331        |
| Area_rural                                    | 0                          | .     | .      | .                  | 0                            | .     | .      | .                  |
| Area_urban                                    | -1.198                     | 0.017 | 0.302  | 0.070-1.294        | -0.199                       | 0.686 | 0.820  | 0.312-2.151        |
| Religion_Hindu                                | 0                          | .     | .      | .                  | 0                            | .     | .      | .                  |
| Religion_Muslim                               | -0.520                     | 0.483 | 0.594  | 0.139-2.544        | -0.151                       | 0.789 | 0.860  | 0.284-2.602        |
| Religion_Sikh                                 | -0.304                     | 0.521 | 0.738  | 0.291-1.869        | -1.237                       | 0.033 | 0.290  | 0.130-0.650        |
| Family type_nuclear                           | 0                          | .     | .      | .                  | 0                            | .     | .      | .                  |
| Family type_Joint                             | 0.068                      | 0.884 | 1.071  | 0.428-2.678        | 0.260                        | 0.488 | 1.297  | 0.622-2.703        |
| Marital status_married                        | 0                          | .     | .      | .                  | 0                            | .     | .      | .                  |
| Marital status_widow/widower                  | 1.217                      | 0.035 | 3.378  | 1.091-4.457        | 0.987                        | 0.046 | 2.684  | 1.016-4.087        |
| Dependency_living independent                 | 0                          | .     | .      | .                  | 0                            | .     | .      | .                  |
| Dependency_dependent on others                | 1.863                      | 0.007 | 3.445  | 1.671-5.852        | 0.927                        | 0.042 | 2.527  | 0.888-3.191        |
| SES_upper                                     | 0                          | .     | .      | .                  | 0                            | .     | .      | .                  |
| SES_middle                                    | 1.560                      | 0.041 | 4.757  | 1.063-6.288        | 0.120                        | 0.818 | 1.128  | 0.405-3.143        |
| SES_lower                                     | 1.586                      | 0.046 | 4.883  | 0.961-6.813        | -0.132                       | 0.819 | 0.877  | 0.284-2.707        |
| Age_(60-64)                                   | 0                          | .     | .      | .                  | 0                            | .     | .      | .                  |
| Age_(65-69)                                   | 0.061                      | 0.421 | 1.063  | 0.466-2.424        | 0.187                        | 0.576 | 1.205  | 0.626-2.319        |
| Age_(70-74)                                   | 1.490                      | 0.703 | 3.436  | 0.360-3.958        | 1.481                        | 0.020 | 2.396  | 0.258-3.357        |
| Age_(75-79)                                   | 0.481                      | 0.766 | 1.617  | 0.360-7.258        | 0.446                        | 0.510 | 1.562  | 0.427-3.310        |
| Age_(80 and above)                            | -0.068                     | 0.844 | 0.935  | 0.179-4.888        | 0.317                        | 0.638 | 1.373  | 0.366-2.157        |
| Category_general                              | 0                          | .     | .      | .                  | 0                            | .     | .      | .                  |
| Category_others                               | -0.220                     | 0.654 | 0.803  | 0.307-2.101        | 0.113                        | 0.758 | 1.120  | 0.544-1.308        |
| Living status_living with spouse and children | 0                          | .     | .      | .                  | 0                            | .     | .      | .                  |
| Living status_living with spouse              | 0.950                      | 0.120 | 2.587  | 0.782-2.989        | -0.242                       | 0.681 | 0.785  | 0.247-4.191        |
| Living status_Living alone                    | -0.427                     | 0.775 | 0.352  | 0.035-1.213        | -0.121                       | 0.913 | 0.0886 | 0.019-1.291        |
| Living status_Living with relatives           | -0.701                     | 0.641 | 0.496  | 0.026-1.407        | 0.177                        | 0.873 | 0.785  | 0.136-1.443        |

Continued.

| Morbidities                                   | Four morbidities versus one |       |        |                    | Five or more morbidities versus one |       |         |                    |
|-----------------------------------------------|-----------------------------|-------|--------|--------------------|-------------------------------------|-------|---------|--------------------|
|                                               | B                           | Sig.  | Exp(B) | 95% CI for Exp (B) | B                                   | Sig.  | Exp (B) | 95% CI for Exp (B) |
| Intercept                                     | -0.609                      | 0.365 |        |                    | -3.693                              | 0.600 |         |                    |
| BMI_normal                                    | 0                           | .     | .      | .                  | 0                                   | .     | .       | .                  |
| BMI_overweight                                | 0.460                       | 0.199 | 1.583  | 0.786-3.191        | 0.720                               | 0.104 | 2.055   | 0.862-3.897        |
| BMI_obese                                     | 1.041                       | 0.229 | 2.832  | 0.519-3.447        | 0.645                               | 0.557 | 1.905   | 0.221-2.405        |
| Gender_female                                 | 0                           | .     | .      | .                  | 0                                   | .     | .       | .                  |
| Gender_male                                   | 0.742                       | 0.209 | 2.100  | 0.660-3.681        | 1.669                               | 0.033 | 1.309   | 0.041-2.698        |
| Area_rural                                    | 0                           | .     | .      | .                  | 0                                   | .     | .       | .                  |
| Area_urban                                    | -0.270                      | 0.010 | 0.764  | 0.271-2.150        | 0.196                               | 0.042 | 1.216   | 0.342-2.321        |
| Religion_Hindu                                | 0                           | .     | .      | .                  | 0                                   | .     | .       | .                  |
| Religion_Muslim                               | 0.200                       | 0.736 | 1.221  | 0.382-3.904        | -0.028                              | 0.970 | 0.972   | 0.221-2.272        |
| Religion_Sikh                                 | -0.951                      | 0.053 | 0.386  | 0.162-0.922        | 0.033                               | 0.951 | 1.033   | 0.366-2.919        |
| Family_type_nuclear                           | 0                           | .     | .      | .                  | 0                                   | .     | .       | .                  |
| Family_type_joint                             | 0.144                       | 0.717 | 1.154  | 0.530-2.513        | 0.664                               | 0.165 | 1.942   | 0.762-1.9511       |
| Marital_status_married                        | 0                           | .     | .      | .                  | 0                                   | .     | .       | .                  |
| Marital_status_widow/widower                  | 1.239                       | 0.015 | 2.154  | 1.270-4.390        | 1.966                               | 0.001 | 1.144   | 0.310-2.097        |
| Dependency_living independent                 | 0                           | .     | .      | .                  | 0                                   | .     | .       | .                  |
| Dependency_dependent on others                | 0.987                       | 0.008 | 2.683  | 0.865-3.323        | 2.023                               | 0.008 | 2.564   | 1.703-3.097        |
| SES_upper                                     | 0                           | .     | .      | .                  | 0                                   | .     | .       | .                  |
| SES_middle                                    | 0.007                       | 0.991 | 1.007  | 0.335-3.026        | 0.339                               | 0.612 | 1.403   | 0.379-5.197        |
| SES_lower                                     | -0.217                      | 0.730 | 0.805  | 0.235-2.759        | -1.301                              | 0.193 | 0.272   | 0.038-1.928        |
| Age (60-64)                                   | 0                           | .     | .      | .                  | 0                                   | .     | .       | .                  |
| Age (65-69)                                   | 0.732                       | 0.047 | 2.079  | 1.010-4.280        | 0.432                               | 0.402 | 1.541   | 0.560-2.236        |
| Age (70-74)                                   | 2.089                       | 0.002 | 1.077  | 0.211-2.511        | 2.090                               | 0.006 | 1.088   | 0.848-3.599        |
| Age (75-79)                                   | 1.625                       | 0.016 | 0.078  | 0.350-2.511        | 0.498                               | 0.588 | 1.645   | 0.272-3.362        |
| Age (80 and above)                            | 1.765                       | 0.010 | 0.839  | 0.520-2.431        | 2.387                               | 0.002 | 1.882   | 1.461-4.122        |
| Category_general                              | 0                           | .     | .      | .                  | 0                                   | .     | .       | .                  |
| Category_others                               | 0.117                       | 0.767 | 1.124  | 0.519-2.438        | -0.281                              | 0.596 | 0.756   | 0.267-2.313        |
| Living status_living with spouse and children | 0                           | .     | .      | .                  | 0                                   | .     | .       | .                  |
| Living status_living with spouse              | -0.046                      | 0.943 | 0.955  | 0.273-3.343        | 0.165                               | 0.859 | 1.179   | 0.192-3.233        |
| Living status_living alone                    | -0.012                      | 0.992 | 0.988  | 0.102-3.534        | 0.060                               | 0.963 | 1.062   | 0.086-2.071        |
| Living status_living with relatives           | -0.485                      | 0.685 | 0.616  | 0.058-2.564        | -0.772                              | 0.610 | 0.462   | 0.024-2.994        |

Parameter estimates of the multinomial regression coefficients, odds ratios of each of the predictor variables in all categories under study with respect to reference category “one morbidity” is shown in (Table 7). It was clearly observed that gender-male, area-urban, marital status-widow/widowers, dependency-dependent on others, SES-middle and SES-lower were the significant predictors of two morbidities versus one morbidity model. It was also clearly observed that religion- Sikh, marital status-widow/widowers, dependency- dependent on others and age- 70-74 years were significant predictors of three morbidities versus one morbidity model and the predictors like area- urban, marital status- widow/widowers, dependency-dependent on others, age- 65-69 years, age- 70-74 years, age- 74-79 years and age- 80 and above years were significant for four morbidities versus one morbidity model respectively. Similarly, predictors gender- male, area- urban, marital status- widow/widowers, and dependency- dependent on others, age- 70-74 and age- 80 and above years were significant for five or more morbidities versus one morbidity model.

The multinomial regression models for categorical variable “number of morbidities P” were:

$$\ln\left(\frac{P_2}{P_1}\right) = -2.208 + 1.909 * \text{Gender\_Male} - 1.198 \\ * \text{Area\_Urban} + 1.217 \\ * \text{Maritalstatus\_Widow/Widower} \\ + 1.863 \\ * \text{Dependency\_Dependent on others} \\ + 1.560 * \text{SES\_middle} + 1.586 \\ * \text{SES\_lower}$$

$$\ln\left(\frac{P_3}{P_1}\right) = 0.664 - 1.237 * \text{Religion\_Sikh} + 0.987 \\ * \text{Maritalstatus\_Widow/Widower} \\ + 0.927 \\ * \text{Dependency\_Dependent on others} \\ + 1.481 * \text{Age\_}(70 - 74)$$

$$\ln\left(\frac{P_4}{P_1}\right) = -0.609 - 0.270 * \text{Area\_Urban} + 1.239$$

\* Maritalstatus\_Widow/Widower  
+ 0.987  
\* Dependency\_Dependent on others  
+ 0.732 \* Age\_(65 – 69) + 2.089  
\* Age\_(70 – 74) + 1.625 \* Age\_(75  
– 79) + Age\_(80 and above)

$$\ln\left(\frac{P_5}{P_1}\right) = 0.600 - 1.669 * \text{Gender\_Male} + 0.196$$

\* Area\_Urban + 1.966  
\* Marital status\_Widow/Widower  
+ 2.023  
\* Dependency\_Dependent on others  
+ 2.090 \* Age\_(70 – 74) + 2.387  
\* Age\_(80 and above)

## DISCUSSION

Ageing was normal irreversible enhancing change in all the living organisms over a chronological period of time. The trend of decreasing percentage of geriatric population with increment of age was observed in our study. Similar findings were observed in studies conducted by different researchers like Bharati et al and many others.<sup>8-12</sup> Like studies conducted by Chaudhary et al and many others, the number of male subjects was predominant in our study as compared to number of females.<sup>10,13,14</sup> But in some other studies conducted by Sahu et al and other researchers, proportion of female subjects outnumbered male study subjects.<sup>9-17</sup> In our study, about two-third of the geriatric population (67.7%) was having normal weight, followed by 28.7% overweight people whereas the remaining 3.6% of the geriatric population was obese. Similar pattern was reported by Prakash et al and Barman et al in their respective studies.<sup>18,19</sup>

Sahu et al reported that mostly geriatric population belonged to urban areas.<sup>17</sup> Similar findings were reported in our study. In our study, most of the people were Hindus (77.9%) followed by Sikhs (11.9%) and Muslims (10.3%). Another study conducted by George et al observed the same pattern in which 89.6% of total geriatric population was Hindus.<sup>20</sup> Bardhan et al and many others also reported that majority population was Hindu.<sup>6,9</sup> Here, 65.1% geriatric people from nuclear families whereas remaining 34.9% geriatric people from joint families. Shraddha et al also reported similar findings in their study.<sup>9</sup>

Banjare et al and many other researchers reported that majority of these people were married.<sup>10,12,15</sup> Similar findings were reported in our study in which 72.5% geriatric people were married followed by 27.5% widow/widowers. In our study, majority of the study subjects (51.7%) were living independent, followed by people who were totally dependent on others (48.3%). Similar trends were observed by Banjare and Pradhan in Bargarh district, Odisha.<sup>15</sup> Like study executed by Gupta et al in Faridabad, Haryana, majority of the geriatric

population (89.5%) included were living with their children and spouse.<sup>21</sup> According to classification of socio-economic status by Modified Kuppuswamy scale, our study reported that 37.9% geriatric people belonged to lower middle class, followed by upper middle class (28.5%), upper lower class (20.5%) and upper class (13.1%). This is contrary to study conducted by Reshmi et al in Karnataka who reported that majority of these people belonged to lower class (70%), followed by upper lower class (29%) respectively.<sup>7</sup> Vision problem (51.5%) was most common morbidity observed in our study followed by arthritis (40.7%), hypertension (39.3%), gastrointestinal disorders (38.1%), cataract (30.0%), diabetes (26.5%), body ache (25.9%), asthma (17.6%), cardiovascular diseases (14.7%), cancer and hearing impairment (10.9%) and so on. Gupta et al also revealed same morbidity pattern where eye problems were observed in 68.1% study subjects followed by hypertension (44.0%), gastrointestinal disorders (38.6%) and so on.<sup>22</sup> Similar findings were detected by Prakash et al and Barman et al in their respective studies.<sup>18,19</sup> In this study, we used multinomial regression model to examine factors responsible for the number of morbidities with respect to the reference category one morbidity. As such there was no study which used this model to examine factors responsible for determining the number of morbidities among geriatric population of India. Our findings reported that gender, marital status, dependency status, socio-economic factors and age were factors mainly responsible for predicting number of morbidities at various levels among the geriatric population with reference category one morbidity. Similar findings were reported by Agrawal and Keshri in a study conducted among the older widows in India in which they predicted that age, religion, dependency status and category were responsible for predicting type of morbidity with no morbidity as the reference category.<sup>23</sup> Our findings were in contrast to a study conducted by Saquib et al among elderly Saudi men which predicted that diet, BMI, exercise were responsible for occurrence of chronic morbidities.<sup>24</sup>

## CONCLUSION

This study highlighted major health problems experienced by geriatric population of Jammu district, Jammu. So, strong efforts are necessary to provide specialized care to this group so that they remain active and contribute to their maximum potential in the society. Identification and prioritization of specialized geriatric services will further enhance their timely medical check-ups. There is a need to strengthen community care setups for the ease and utilization of these services by this group of vulnerable population.

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