Prevalence of frailty and its association with lifestyle factors among elderly in rural Bengaluru

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ABSTRACT

Background: There are nearly 10.4 crores elderly in India, with 65% of them living in rural areas. Accessibility to healthcare is limited in rural areas. Primary care physicians deal with a fairly large number of patients from the geriatric age group. With the steady increase in the proportion of elderly, there is a corresponding increase in the prevalence of frailty. Frailty among the elderly leads to increased dependency, adverse health outcomes and mortality. Early identification and targeted interventions by primary care physicians could prevent these adverse outcomes and even reverse its occurrence. Knowledge about environmental and lifestyle influences on frailty would further assist primary care physicians to prevent and manage it optimally. Methods: We interviewed 502 participants (>60 years of age) from four taluks of rural Bengaluru. Participants with frailty scores of 3 and above were considered frail, scores of 1-2 were considered prefrail. Association of frailty with lifestyle and environmental factors were tested using the Chi-square test. A value of $P < 0.05$ was considered significant. Results: Prevalence of frailty was 24.70% and prefrailty was 62.75%. Elders in age group 60 to 74 years, those living alone or with others (other than the spouse), illiterate, working elders, elderly with less than two diagnosed comorbidities, elderly with low social score and low physical activity were associated with frailty. Conclusion: The young old population seems vulnerable to frailty. Health programs aimed at prevention, early detection and treatment of morbidities and frailty will improve their health.

Keywords: Bengaluru, environmental factors, frailty, lifestyle, rural

Introduction

The elderly population is growing worldwide and there are nearly 138 million elderly persons in India in 2021, which is expected to increase by around 56 million by 2031. With the increasing elderly population, concomitant comorbidities and the old age dependency ratio will also rise. The old age dependency ratio is 15.7% in 2021 and is projected to rise to 20.1% by 2031.[3]

Frailty can be defined as a progressive loss of reserve and adaptive capacity associated with an overall deterioration in health.[3] Frailty, an age-related clinical state of increased vulnerability to stressor events, is on the rise in tandem with the unprecedented growth in the world’s older adult population. Lower social involvement and quality of life, increased dependency, and higher rates of morbidity, health-care consumption, and mortality come from this increased vulnerability. Frailty further pushes the elderly towards dependency. Family physicians are the first and sometimes the sole contact of care. Hence, they are in a position to assess them, detect and prevent frailty. Frailty must be identified early in order to guide the deployment of therapies to prevent functional decline. It allows for the foreseeing of future disability before the individual becomes disabled.[3]
Lifestyle is referred as the characteristics of inhabitants of a region at a specific time and place. It includes day to day behaviors and functions of individuals in job, activities, fun and diet.\cite{8} Lifestyle factors such as physical activity, intellectual stimulation and leisure activities are associated with good physical and mental health. According to WHO, 60% of factors related to individual health and quality of life are correlated to lifestyle.\cite{5} Malnutrition, unhealthy diet, unhealthy habits, substance abuse and sedentary activities are the characteristics of an unhealthy lifestyle. Poor lifestyle is associated with frailty.\cite{9} Several studies have reported adverse lifestyle factors such as low physical activity, low diet quality and smoking being associated with frailty, independent of functional impairment.\cite{6,7} Frailty has five components. i.e., low physical activity, unintentional weight loss, fatigue, slowness and weakness. There are but a few studies and reports on frailty especially among the rural communities in India. This study reports on the prevalence of frailty and its association with lifestyle factors including physical activity, social activity, diet and habits of smoking, tobacco usage and alcohol in a rural population in Karnataka.

Materials and Methods

The study was approved by the Institutional Ethics Committee. The study was registered in Clinical Trial Registry of India (REF/2018/03/019167).

This community-based cross-sectional study was conducted among 502 elderly people selected from the four taluks of Bengaluru rural district from September 2017 to December 2018. The demographic characteristics of study participants are detailed in Table 1. All patients aged above 60 years old of both genders were invited to participate in the study. The sample size was calculated using a prevalence of frailty of 28% in population above 60 years of age,\cite{8} with an absolute precision of 4% and using the formula \(4 \times pq/d^2\). Multistage cluster sampling was done with the village as the unit.

Tool

The study used a questionnaire that consisted of three parts. The first part comprised of demographics (name, age, gender, place, education), environmental factors (living arrangements such as house type and marital status and social support, namely type of family and occupation) and comorbidities. The second part comprised of Fried Frailty criteria defined by Fried LP et al.\cite{9} Third part assessed their lifestyle (physical activity using short version of international physical activity questionnaire, social activity, balanced diet considering Mediterranean diet as the ideal diet, habits of smoking, alcohol, betel leaves and tobacco consumption) as mentioned in the Table 2.

We applied Fried et al’s definition as an indicator of frailty, which provided a potential standardized definition for frailty and validated the measurements. The dependent variables were divided into three categories: “non-frailty”, “pre-frailty”, and “frailty”. Participants with three or more of the five criteria were categorized as those exhibiting frailty, with one to two criteria as those exhibiting pre-frailty, and with none of the criteria as those exhibiting non-frailty. The five criteria were:

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### Table 1: Demographic characteristics of study participants (n=502)

| Characteristics | Number (%) |
|-----------------|------------|
| Gender          |            |
| Male            | 274 (54.6) |
| Female          | 228 (45.4) |
| Age (in years)  |            |
| 60-74           | 364 (72.5) |
| 75-84           | 106 (21.1) |
| >= 85           | 32 (6.4)   |
| Educational qualification |        |
| Illiterate      | 286 (57.0) |
| Literate        | 216 (43.0) |
| Occupation      |            |
| Not working     | 98 (19.5)  |
| Working         | 404 (80.5) |
| Type of family  |            |
| Nuclear         | 109 (21.7) |
| Others          | 393 (78.3) |
| Marital status  |            |
| Living with spouse | 306 (61.0) |
| Living alone/with others (other than the spouse) | 196 (39.0) |
| House type      |            |
| Kuccha          | 60 (12.0)  |
| Pucca           | 442 (88.0) |
| Diagnosed comorbidities |   |
| >=2 comorbidities | 56 (11.2) |
| <2 comorbidities | 446 (88.8) |

### Table 2: Lifestyle characteristics

| Lifestyle characteristics | Number (%) |
|---------------------------|------------|
| Physical activity         |            |
| Good                      | 466 (92.83) |
| Low*                      | 36 (7.17)  |
| Social activity           |            |
| Good                      | 369 (73.51) |
| Low                       | 133 (26.49) |
| Balanced diet             |            |
| Yes                       | 302 (60.16) |
| No                        | 200 (39.84) |
| Alcohol                   |            |
| Current/Ex                | 101 (20.12) |
| Never                     | 401 (79.88) |
| Smoking                   |            |
| Current/Ex                | 126 (25.10) |
| Never                     | 376 (74.90) |
| Betel leaves              |            |
| Current/Ex                | 340 (67.73) |
| Never                     | 162 (32.27) |
| Tobacco chewing           |            |
| Current/Ex                | 83 (16.54)  |
| Never                     | 419 (83.46) |

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*Low physical activity is males expending <383 kcal/week, females expending <220 kcal/week.

*Good social score is 5 to 8, low social activity is score <5

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\(d\) is the distance from the circle's center to the point on the circumference. It's a measure of how far the point is from the center. The formula \(4 \times pq/d^2\) is used to calculate the sample size. The formula is derived from statistical principles, specifically in the field of epidemiology, to determine the appropriate sample size for a study. The denominator \(d^2\) represents the precision of the study, which is typically set at a level of 4% in this case. The numerator \(4 \times pq\) is an estimate of the prevalence of the characteristic being studied in the population. In this scenario, \(p\) and \(q\) are the proportions of the characteristic, with \(q\) being the proportion of the opposite characteristic. The goal is to ensure that the sample size is adequate to detect a meaningful difference with a specified level of statistical power.
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- Unintentional weight loss >4.5 kg in last 1 year or BMI <18.5\[1\]
- Self-described exhaustion
- Weakness
- Slowness
- Low physical activity.

Here we considered BMI <18.5 as low weight, as most of the elderly in our population did not know their initial weight to calculate the weight loss.\[2\]

Weakness- grip strength was stratified by sex and BMI and measured using a Jamar handheld dynamometer\[9\] [Table 3].

Slowness – Participants were timed while walking 15 feet. Stratified by sex and height, men who were <=173 cm tall and required >=7 seconds, or were >173 cm tall and required 6 seconds, were considered slow. Women who were <=159 cm tall and required >=7 seconds, or were >159 cm tall and required 6 seconds, were considered slow.\[9\]

Physical activity was determined using the short version of International Physical Activity Questionnaire, which was used to calculate kilocalories expended per week. (Number of days of physical activity in a week * duration of activity in minutes * number of kilocalories expended per minute).

Physical activity was said to be low, if men expended <383 kcal/week or women expended <270 kcal/week.\[9\]

Social activities were categorized based on frequency of activities per month as- all days of the month, most days of the month, some days and none of the days.

The activities were
- Visiting others
- Entertaining others at home
- Going out to eat with
- Hobby
- Travelling out of town
- Meeting children/relatives
- Attending gatherings
- Chatting with neighbors.\[13\]

The activities, if done on all days of month or most of the days of month were being scored one, while lesser than that were scored zero. Total maximum score was eight. A score of zero to four was classified as low social activity, and score of five to eight was classified as good social activity.

Balanced diet - Mediterranean diet was modified to adapt South Indian rural food habits (fish being an infrequent part of the meal) to form a balanced diet i.e., protein (adequate fish/poultry/egg/pulses) + carbohydrates (adequate cereals) – (red meat/sweets).

In rural areas, meals are usually taken two times a day, so cereals are consumed twice a day in sufficient quantity, while in western countries, the quantity is less, but more frequent meals are taken.

Habits- Smoking, alcohol, betel chewing and tobacco chewing were categorized based on frequency of consumption. They were further classified as never and current or reformed habits.

Statistical analysis
Data was analyzed with IBM SPSS version 16 software. Descriptive statistics was shown by tables and figures. Chi-square analysis was done to find the factors associated with frailty. P value <0.05 was considered as cut-off for statistical significance.

Results
54.59% were males, 72.52% of total participants were aged between 60 and 74 years. 56.98% were illiterate with 80.47% people still continuing to work. Joint and extended families (other types of families) were common (78.28%) while 39.04% people lived alone/with others (divorced/widowhood/separated/unmarried) with 67% being females. 11.16% had more than one comorbidity.

The prevalence of frailty and prefrailty were 24.70% (95% CI 22.8% to 26.6%) and 62.75% (95% CI 60.5% to 64.8%) respectively [Table 4].

Chi-square analysis showed that the elderly in the age group of 60 to 74 years, living alone or with others (other than the spouse), illiterates, working elders, elderly with less than two diagnosed comorbidities, elderly with low social score and low physical activity were found to be significantly associated with frailty (p < 0.05). The association of lifestyle with environmental factors on frailty is mentioned in Table 5.

| Table 3: Grip strength cut-off for frailty |
|-----------------|-----------------|
| Grip strength   | Cut-off for frailty (kg) |
| Males BMI <=24  | <= 29            |
| Males BMI 24.1-28 | <= 30            |
| Males BMI >28   | <= 32            |
| Females BMI <=23 | <= 17            |
| Females BMI 23.1-26 | <= 17.3         |
| Females BMI 26.1-29 | <= 18            |
| Females BMI >29  | <= 21            |

| Table 4: Prevalence of frailty and prefrailty |
|-----------------|-----------------|
| Frailty status  | Prevalence      |
| Frail           | 124 (24.7)      |
| Pre-frail       | 315 (62.7)      |
| Non-frail       | 63 (12.5)       |
Discussion

Frailty plays a major role in health status of the elderly. The elderly who are frail are at a higher risk of adverse health outcomes and mortality. Frailty is a reversible condition and its early identification by primary care physicians through community-based screening can help prevent adverse outcomes through targeted interventions like cognitive training and physical exercise.\(^{14,15}\)

The prevalence of frailty among the elderly living in rural Bengaluru was 24.70% and prefrailty was 62.75%. A study done in rural Tanjavur\(^8\) found a prevalence of 28%, while another study done by Kashikar et al.\(^{16}\) reported a prevalence of frailty to be 26% and prefrailty was 63.6%, which are very similar to our findings. Another study done in rural west Bengal\(^{17}\) reported a prevalence of 38.8% which was higher than what we found. A recent meta-analysis on prevalence of frailty in low-income middle-income countries (LMICs) reported a higher prevalence

### Table 5: Association of lifestyle with environmental factors on frailty

| Characteristics                          | Frailty no (%) | χ²     | P     |
|----------------------------------------|---------------|--------|-------|
| Gender                                 |               |        |       |
| Female                                 | 61 (26.8)     | 0.94   | 0.33  |
| Male                                   | 63 (23)       |        |       |
| Age                                     |               |        |       |
| 60-74                                   | 68 (54.84)    | < 0.001|       |
| 75-84                                   | 40 (32.26)    |        |       |
| 85 and greater                         | 16 (12.90)    |        |       |
| House type                              |               |        |       |
| Pucca                                   | 106 (24)      | 1.02   | 0.31  |
| Kuccha                                  | 18 (30)       |        |       |
| Marital status                          |               |        |       |
| Living with spouse                      | 61 (19.9)     | 9.57   | 0.0019|
| Living alone or with others (other than the spouse) | 63 (32.1) |        |       |
| Type of family                          |               |        |       |
| Nuclear                                 | 27 (24.8)     | 0.0004 | 0.98  |
| Others                                  | 97 (24.7)     |        |       |
| Education                               |               |        |       |
| Literate                                | 37 (17.1)     | 11.68  | 0.0006|
| Illiterate                              | 87 (30.4)     |        |       |
| Occupation                              |               |        |       |
| Working                                 | 50 (51)       | 45.35  | 0.000001|
| Not working                             | 74 (18.3)     |        |       |
| Diagnosed Comorbidities                 |               |        |       |
| Less than 2                             | 117 (26.2)    | 5.04   | 0.024 |
| 2 or more                               | 7 (12.5)      |        |       |
| Balanced diet                           |               |        |       |
| Yes                                     | 73 (24.2)     | 0.11   | 0.73  |
| No                                      | 51 (25.5)     |        |       |
| Alcohol                                 |               |        |       |
| Current/Ex                             | 25 (24.75)    | 0.0002 | 0.98  |
| Never                                   | 99 (24.68)    |        |       |
| Smoking                                 |               |        |       |
| Current/Ex                             | 32 (25.3)     | 0.04   | 0.83  |
| Never                                   | 92 (24.46)    |        |       |
| Tobacco                                 |               |        |       |
| Current/Ex                             | 16 (19.2)     | 1.57   | 0.20  |
| Never                                   | 108 (25.7)    |        |       |
| Betel leaves                            |               |        |       |
| Current/Ex                             | 85 (25)       | 0.05   | 0.82  |
| Never                                   | 39 (24.07)    |        |       |
| Social score                            |               |        |       |
| Good                                    | 68 (18.42)    | 29.46  | 0.000001|
| Low                                     | 56 (42.1)     |        |       |
| Physical activity                       |               |        |       |
| Good activity                           | 92 (19.7)     | 85.90  | 0.000001|
| Low activity                            | 32 (88.8)     |        |       |
of frailty (12.3%) and pre-frailty (55.3%) in LMICs compared with high-income countries (8.2%, 43.9%). The differences in prevalence of frailty could be attributed to the cultural diversity and individual subjectivity that could have played a role on the responses to the questionnaire and performance assessment. The Fried criteria consider self-reported exhaustion as one of the criteria for frailty. Since perception of exhaustion varies among individuals and is subjective, this might have contributed to the varying prevalence of frailty.

Advancing age has been shown to be associated with increased prevalence of frailty, but we found that the proportion of frailty among elders aged between 60 to 74 years (young old) was highest as compared to groups aged 75 to 84 years (middle old) and 85 years and older (old old). There is progressive, universal deterioration in physiological systems with ageing, which supports the hypothesis of frailty being higher in advanced age groups. However, our study mostly consisted of participants belonging to the age group of 60 to 74 years working in agricultural fields, living in rural areas with poor health infrastructure and poor social security like old-age pension, occupational injury and sickness benefit, as it is an unorganized sector. There is no cut-off age as retirement in this sector. The poor among the “young old” group may continue to work to meet their basic needs, till their physical capacity permits. This physical work might expose them to higher risk of fall, injuries and increased risk of diseases, thus increasing the risk of frailty among the working elderly of this age group.

Contrary to expectation, this study found that having less than 2 comorbidities was associated with frailty. This might be because many of them may have undiagnosed morbidities due to them seeking healthcare only when they fall ill. Some of them said that they have never been to a hospital in their lifetime.

Environmental factors, such as social support (type of family and occupation) and living arrangement (type of house and marital status) were assessed. The type of house or type of family did not show any increased risk of frailty.

Elders living alone or with others (other than the spouse), those with a low social score and elders who are currently working had a significant association with frailty. In a study reported by Kashikar Y et al., frail and pre-frail individuals reported higher levels of social isolation. The younger population from rural areas migrates to urban areas for education or employment. The elders are left alone in their homes and them, (especially those without a spouse) are lonely and have poor social interaction. Less frequent social contact with friends is shown to have higher odds of frailty.

Kendhapedi KK et al. and Dasgupta et al. reported that illiteracy had higher odds of frailty. Lower level of frailty was associated with higher level of education as reported by Biritwum RB et al. Lack of formal education limits the job availability, thereby ending up in low-paying physical jobs which makes them vulnerable to injuries, falls and diseases. Literacy empowers them through behavioral change, improved cognition and better health literacy. Thus elders with low educational level have higher odds of frailty.

Elders with lower physical activity have higher odds of developing frailty. Frailty worsens over time in elders with sedentary behavior. Low physical activity combined with excessive sedentary behavior is also associated with frailty. Frailty in turn leads to increased physical dependence. It is a vicious cycle which should be broken by being physically active and reducing sedentary behavior.

Lifestyle factors such as habits (alcohol/smoking/tobacco/betel leaves) and balanced diet do not seem to affect the risk of developing frailty in our study. Smoking (current/past) and alcoholism were predictors of frailty in studies by Strawbridge et al. and Peter Hanlon et al. Smoking, alcohol was associated with malnutrition in elderly in Taiwan, while none of the habits or balanced diet influenced frailty.

Strengths

We conducted a community-based study in rural Bengaluru, which is one of the very few studies done in South India. Even though there are studies reported from rural areas of India on frailty, very few have looked at the influence of environmental and social factors on frailty. Our study demonstrates importance of targeting young old population (60-74 age group) to prevent and reduce frailty in them.

Limitations

- Our study does not evaluate mental status like depression, anxiety and poor cognition status, which are quite common in elderly.
- Self-reported exhaustion (one of the criteria for frailty) is subjective.
- Physical activity is higher in our area, as it was conducted in rural villages where the elderly are engaged in agricultural activities, even with advancing age. Hence very few reported lower physical activity.

Implications for future

Sixty five percent of India’s population lives in rural areas. The increasing numbers of the elderly and the concomitant rise in the prevalence of frailty would put an enormous burden on the already overstretched health services and also have an impact on the cost of healthcare provision. Unfortunately, neither is our healthcare system nor health care professionals are equipped or competent enough to manage the elderly patients. Effective change right from health policy making to preparedness of health care systems as well as sensitization and training of health care professionals in the prevention and multi-dimensional management of frailty will help in providing better care to this vulnerable group.
Conclusion

With the continuous increase in the elderly population, the prevalence of frailty is expected to rise. Prevalence of frailty in this elderly rural population studied is 24.70%. The young old population (60-74 years) seems to be more vulnerable to frailty as compared to other older age groups. Illiteracy, living alone or with others, working elderly, and lifestyle characteristics such as low physical and social activities are all found to be associated with frailty. Primary care physicians will be better equipped to detect, manage and prevent frailty if they are cognizant of the social and environmental factors that influence frailty among their elderly patients.

Ethical approval

“All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.”

Informed consent

All “Informed consent was obtained from all individual participants included in the study.”

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Conflicts of interest

There are no conflicts of interest.

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