Trends in frailty and its associated factors in the community dwelling elderly Indian population during the COVID-19 pandemic: A prospective analytical study [version 3; peer review: 1 approved]

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Abstract

Background: There is a scarcity of quality literature on the prevalence of frailty among community dwelling elderly in India. This study was originally planned to analyze the longitudinal trends in frailty status of community dwelling elderly in an Indian population as well to identify factors associated with frailty in the Indian context. However, the recruitment phase of this study coincided with one of the largest lockdowns in history, associated with the COVID-19 pandemic, and this gave us a unique opportunity to study the effects this pandemic enforced, as a result of the necessary restrictions, on the frailty status as well the factors affecting frailty in the elderly.

Methods: A prospective observational study was designed and conducted amongst 19 community dwelling elderly of Dakshina Kannada District, in Karnataka India. Outcome variables of frailty (EFIP), physical activity (PASE), functional mobility (TUG), gait speed (10-meter walk test), nutritional status (MNA®-SF) body composition (BIA), and strength (dynamometry), were measured at baseline and on follow-up after three months. The changes occurring in these variables over the three-month period were analyzed and the change in frailty was independently correlated with changes in each of the other outcomes.

Results: We couldn't identify any statistically significant difference in frailty over a period of three months. However, there was a highly significant change in the physical activity status, lower extremity muscle strength, body composition, functional mobility, gait speed, and cognitive function in the same time period.

Conclusions: Though individual determinants of frailty in community dwelling changed over a three-month period, these changes failed to produce any observable/measurable difference in frailty status.
Keywords
frailty, COVID-19 pandemic, sarcopenia, functional mobility
List of abbreviations
BMR: Basal metabolic rate
EFIP: Evaluative Frailty Index for Physical Activity
MNA®-SF: Mini Nutritional Assessment Short Form
MOCA: Montreal Cognitive Assessment
PASE: Physical Activity Scale for the Elderly
TUG: Timed Up and Go
WHO: World Health Organization

Introduction
Frailty derived from the Latin word ‘fradilita’ meaning brittleness, is an important and emerging term in geriatric medicine.1 There is no definition that is internationally recognized, but it is usually associated with adverse outcomes developed as a consequence of increased vulnerability. It refers to a decline in physiological systems with increasing age triggered by any minor stressor, which collectively leads to sudden changes in state of health.2 Frailty is a geriatric syndrome, which is multidimensional in nature. In 2017, the World Health Organization (WHO) defined frailty as “a clinically recognizable state in which the ability of older people to cope with every day or acute stressors is compromised by an increased vulnerability brought by age-associated declines in physiological reserve and function across multiple organ systems” .3

According to the WHO, 900 million people around the world are classified as being in an elderly age group, out of which there are 104 million elderly (>60 years of age) in India. It is also estimated that India will hold the largest geriatric population around the globe by the year 2050.4 With the advancement in medical sciences there is a decrease in mortality rates, life expectancy is increased and so is frailty among the elderly.5 It is estimated that 4% to 10% of the elderly population dwelling in the United States are frail, also 8.1% of the elderly are observed to be frail in the United Kingdom, and 6.5% and 7% in Italy and France respectively.6

A large compressive study by the WHO showed that among middle- and low-income countries (South Africa, China, Russia, Ghana, India and Mexico) India has the highest prevalence of frailty (i.e., 56.9%) and a greater number of women are frail compared to men (47% of elderly men and 67% of elderly women).7,8

The evaluation of frailty is difficult because of a lack of any standardized tool. There are 67 tools for quantifying frailty, out of which only nine of these screening tools are highly cited (more than 200 citations).9 Phenotype of frailty10 and Frailty index11 are the validated and most widely used screening tools.9 The phenotype of frailty model defines a person as frail when three or more physiological deficits out of five are present,10 whereas the frailty index model expresses frailty as a “ratio of existing deficits to the total probable deficits there could be”. These deficits are defined as a wide range of diseases, disabilities, signs and symptoms.11

Ageing leads to numerous changes in the physiological systems of the body, which are fundamental to the development of frailty, specifically the immunological system, the neuromuscular system and neuroendocrine system.12 These changes in the body interact progressively and adversely, leading to loss of physiological function and reserve (state

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of compromised homeostasis. The risk factors for frailty are varied and have been found to have multiple linear and non-linear interactions. For example, a consequence of normal ageing leads to loss of muscle mass and strength. Muscle loss can also be accelerated due to chronic illness, poor nutrition, decrease in growth hormone production, and reduced physical activity. All these factors are inter-related to each other through complex interactions and ultimately lead to frailty. Socio economic and demographic variables like availability of disposable income/finances, level of education, nutritional status, and general living conditions have been found to be confounders of frailty.

Several studies have identified factors like sarcopenia, loss of muscle strength, functional mobility and gait velocity changes, loss of weight, reduced physical activity and easy exhaustibility to be strong independent confounders of frailty. The most closely associated biological parameters of frailty have been identified as inflammatory markers, dyslipidemic markers, endocrinological markers, insulin resistance and state of glycemia.

Available literature on the feasibility of predicting frailty state that changes in functional as well as biological parameters could be used as well qualified candidates to estimate and quantify frailty. Out of these risk factors, it is purported that functionality could be the strongest predictor or measurer of frailty. Sarcopenia, connective tissue remodeling, and inflammatory marker mediated physiological and functional changes and their interaction as well as other confounders of frailty need to be studied to develop a predictive model of frailty.

A recent large-scale review on the state of frailty related research in India stated that there is a rather alarming lack of conceptualization or epidemiological data regarding frailty in an Indian scenario, and there is a dire need to identify the key confounders for frailty syndrome among Indian elderly. There is a scarcity of quality literature on the prevalence of frailty among community dwelling elderly in India. This study was originally planned to analyze the longitudinal trends in frailty status of community dwelling elderly in an Indian population as well to identify factors associated with frailty in the Indian context. However, the recruitment phase of this study coincided with one of the largest lockdowns in history, mandated to minimize the spread of COVID-19 in India. Restrictions were put in place to minimize the outdoor movement of the population in general and specifically the elderly, who were recognized to be the most vulnerable group with respect to the pandemic. This gave us a unique opportunity to study the effects this pandemic enforced, as a result of the necessary restrictions, on frailty status as well as the factors affecting frailty in the elderly.

The primary objective of the study was to identify the changes in frailty status occurring in a group of community dwelling elderly over a period of three months, during a phase of reduced social mobility due to the COVID-19 imposed lockdown. The study also aimed to identify the changes, if any, that occurred in certain recognized predictors of frailty such as muscle strength, body composition, flexibility, physical activity, cognitive function, and nutritional status.

**Methods**

A prospective observational study was designed and after obtaining the necessary permission to recruit subjects, the study recruitment commenced in March 2020. The study was approved by the Scientific and Institutional Ethics committee of KMC Mangalore (IEC KMC MLR 11-19/590). All stages of the study were conducted in strict adherence to the principles of the “Helsinki Declaration” for research on human subjects.

**Study setting**

The study was conducted among a group of community dwelling elderly of either gender, residing in Mangalore city, of Dakshina Kannada district, of Karnataka state, India. Subjects were recruited from the various community outreach centers operated by the Department of Physiotherapy, KMC Mangalore, within the Mangalore city limits. Flyers were sent out through these outreach centers inviting interested participants. The recruitment period of the study coincided with the beginning of the ongoing SARS COVID 19 pandemic, which proved to be a major hindrance in approaching, screening and evaluating elderly subjects. Over the period of study, a total of 28 subjects were screened, of which 22 fulfilled the criteria of inclusion in the study.

**Participants**

The criteria for inclusion were that age must be greater than 65 years, and the Montreal Cognitive Assessment (MOCA) score was greater than 26 at the time of first evaluation. Subjects with a known diagnosis of any progressive disorder, as well as those with cardiovascular, musculoskeletal, neurological or systemic illness, which could potentially interfere with data collection, were excluded. Since independent mobility was a basic requirement for the assessment of outcome measures such as Gait speed and functional mobility, those who couldn’t independently ambulate at the time of first evaluation were excluded.
Outcome variables and follow-up

Subjects’ demographics as well as medical history were recorded using self-administered questionnaires and checklist following which an Evaluative Frailty Index for Physical Activity (EFIP) questionnaire was administered to identify and quantify frailty among them. Lower extremity and Upper extremity muscle strength was evaluated using a Baseline hand-held dynamometer. Strength of bilateral Shoulder flexors, Extensors, Adductors, Abductors, Elbow Flexors and Extensors in the upper extremities as well as Hip Flexors, Extensors, Adductors, Abductors, Knee Flexors, and Extensors, in the Lower extremities, were evaluated following standard test procedures for dynamometry. A Tanita (UM076) Segmental Body Composition analyzer was used to determine the body composition variables of muscle mass, visceral fat and total body fat percentage for each subject. Subjects were then made to do a 10-meter walk test to analyze the gait velocity following which the nutritional status and socioeconomic status were evaluated using Mini Nutritional Assessment Short Form (MNA®-SF) and BG Prasad scale respectively. Physical activity level was recorded using the Physical Activity Scale for the Elderly (PASE) scale following which a timed up and go test was then performed to analyze the functional mobility status. Physical Activity Scale for the Elderly (PASE) is an easily administered and scored instrument that measures the level of physical activity in elderly. The instrument is a self-reported questionnaire collecting information on common household and leisure activities over a period of one week, and can be administered directly, through mail, or through a telephone interview. Each subject was then given a date exactly three months from the date of the first evaluation for the follow-up assessment. All data from all subjects were collected by the primary author at baseline and subsequent follow-up.

Unexpectedly, India went into complete lockdown in the third week of March 2020 following the rise of COVID-19 cases, which in its strict form lasted for approximately 70 days, following which there was a phased gradual unlock. Our follow-up data collection coincided with phase two of unlock but still there was a general advisory for elderly subjects to be home bound to minimize chances of exposure. Of the 22 subjects recruited only 19 subjects returned for the timely follow up evaluation. All the outcomes were again collected using the same tools and in the same order at the end of the third month.

Data analysis

The data was collected and analyzed using JAMOVI version 1.6.14. (RRID:SCR_016142) statistical software. Normality of continuous variables was tested using the Shapiro-Wilk test. Demographic variables were expressed in terms of descriptive statistics. Differences in gait velocity, strength, body composition and functional mobility at baseline and at three months of follow-up were analyzed using the Wilcoxon signed-rank test/Students paired sample T-test. Changes in scores of the independent variables were individually associated with changes in scores in the Evaluative Frailty Index for Physical Activity questionnaire using the Spearman’s Correlation test.

Results

A total of 28 subjects were screened of which 22 were recruited after fulfilling the inclusion and exclusion criteria. Of the 22 recruited subjects, only 19 returned for follow-up evaluation and hence the data of only these participants were analysed. The demographic data of all participants are represented in Table 1. The characteristics of the participants such as gender, marital status, height, education level are presented in Table 2.

We found there was neither a statistically nor a clinically significant change in the frailty status of the studied elderly, over the three-month period. However a statistically significant difference was observed in MOCA (Mean difference = 0.7368, p < 0.05), TUG (Mean difference = -0.64, p < 0.05), Body fat percentage (Mean difference = -0.3632, p < 0.05), Visceral fat (Mean difference = -0.4211, p < 0.05), 10 meter walk test (Mean difference = -1.097, p < 0.029), Muscle mass (Mean difference = -0.55, p < 0.05), and PASE scores (Mean difference = -43, p < 0.05) (Table 3).

Comparison of muscle strength of bilateral major muscle groups over the three-month period, revealed that there was a statistically significant reduction in the strength of the left shoulder extensor, adductor, and abductor, elbow flexors on

| Table 1. The demographic data of all participants. |
| --- | --- |
| Age (years) | Mean ± SD |
| 74.2 ± 8.13 |
| Height (cm) | 160 ± 7.16 |
| Weight (kg) | Baseline |
| 64.2 ± 8.69 |
| Three-month follow-up | 64.3 ± 8.62 |
both sides, and elbow extension on the right side. In the lower extremities there was a statistically significant reduction in the strength of all major muscle groups (Table 4).

On analysis of the relationship between the change in frailty status as measured by EFIP, and the other outcome variables, we found that none of the variables among cognitive function, body composition, functional mobility, muscle strength, or gait speed showed any statistically significant correlation with EFIP (Table 5). The entirety of data collected for the study is available in an anonymized form at OSF, as a registered project.19

Table 2. Characteristics of gender and other sociological variables among the studied population.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Percentage (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>63.2%</td>
</tr>
<tr>
<td>Female</td>
<td>36.8%</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>57.9%</td>
</tr>
<tr>
<td>Unmarried</td>
<td>5.3%</td>
</tr>
<tr>
<td>Widowed</td>
<td>36.8%</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>1 (Uneducated)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>2 (1–5th standard)</td>
<td>26.3%</td>
</tr>
<tr>
<td>3 (6–10th standard)</td>
<td>31.6%</td>
</tr>
<tr>
<td>4 (11–12th standard)</td>
<td>15.8%</td>
</tr>
<tr>
<td>5 (Graduate)</td>
<td>26.3%</td>
</tr>
<tr>
<td>6 (Post-graduate)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>B G Prasad</td>
<td></td>
</tr>
<tr>
<td>I (Rs.7008/month and above)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>II (Rs.3504–7007/month)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>III (Rs.2102–3503/month)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>IV (Rs.1051–2101/month)</td>
<td>15.8%</td>
</tr>
<tr>
<td>V (Rs.1050/month and below)</td>
<td>84.2%</td>
</tr>
</tbody>
</table>

Table 3. Change in outcome variables at baseline and at three-month follow-up.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean difference</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water content</td>
<td>-0.0632%</td>
<td>0.786</td>
</tr>
<tr>
<td>MOCA</td>
<td>0.7368</td>
<td>0.007*</td>
</tr>
<tr>
<td>TUG</td>
<td>0.64s</td>
<td>0.001*</td>
</tr>
<tr>
<td>Body fat</td>
<td>0.3632%</td>
<td>0.009*</td>
</tr>
<tr>
<td>Visceral fat</td>
<td>0.4211%</td>
<td>0.004*</td>
</tr>
<tr>
<td>10 m walk test</td>
<td>1.097s</td>
<td>0.029*</td>
</tr>
<tr>
<td>EFIP</td>
<td>0.625</td>
<td>0.138</td>
</tr>
<tr>
<td>BMR</td>
<td>-3</td>
<td>0.815</td>
</tr>
<tr>
<td>Muscle mass</td>
<td>-0.55 kg</td>
<td>0.009*</td>
</tr>
<tr>
<td>PASE</td>
<td>43</td>
<td>0.003*</td>
</tr>
</tbody>
</table>

*Statistically significant.

Table 4. Mean difference between baseline muscle strength and three-month follow-up for 19 participants.

<table>
<thead>
<tr>
<th>Muscle group</th>
<th>Right Mean difference</th>
<th>p-value</th>
<th>Left Mean difference</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder flexion</td>
<td>-0.421 kg</td>
<td>0.016</td>
<td>-0.316</td>
<td>0.055</td>
</tr>
<tr>
<td>Shoulder extension</td>
<td>-0.786 kg</td>
<td>0.001</td>
<td>-0.786</td>
<td>0.001*</td>
</tr>
</tbody>
</table>
### Table 4. Continued

<table>
<thead>
<tr>
<th>Muscle group</th>
<th>Right Mean difference</th>
<th>p-value</th>
<th>Left Mean difference</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder adduction</td>
<td>-0.474 kg</td>
<td>0.046</td>
<td>-0.579</td>
<td>0.03*</td>
</tr>
<tr>
<td>Shoulder abduction</td>
<td>-0.421 kg</td>
<td>0.072</td>
<td>-0.842</td>
<td>0.001*</td>
</tr>
<tr>
<td>Elbow flexion</td>
<td>-0.632 kg</td>
<td>0.001*</td>
<td>-0.632</td>
<td>0.001*</td>
</tr>
<tr>
<td>Elbow extension</td>
<td>-1.211 kg</td>
<td>0.014*</td>
<td>-1.158</td>
<td>0.287</td>
</tr>
<tr>
<td>Hip flexion</td>
<td>-0.263 kg</td>
<td>0.001*</td>
<td>-0.947</td>
<td>0.001*</td>
</tr>
<tr>
<td>Hip extension</td>
<td>-0.789 kg</td>
<td>0.001*</td>
<td>-1.053</td>
<td>0.001*</td>
</tr>
<tr>
<td>Hip abduction</td>
<td>-1.053 kg</td>
<td>0.001*</td>
<td>-1</td>
<td>0.001*</td>
</tr>
<tr>
<td>Hip adduction</td>
<td>-0.737 kg</td>
<td>0.001*</td>
<td>-0.895</td>
<td>0.001*</td>
</tr>
<tr>
<td>Knee flexion</td>
<td>-0.684 kg</td>
<td>0.012*</td>
<td>-1</td>
<td>0.001*</td>
</tr>
<tr>
<td>Knee extension</td>
<td>-0.579 kg</td>
<td>0.001*</td>
<td>-0.632</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

*Statistically significant.

### Table 5. Correlation between EFIP and other outcome variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Correlation coefficient</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>0.119</td>
<td>0.628</td>
</tr>
<tr>
<td>MOCA</td>
<td>-0.044</td>
<td>0.859</td>
</tr>
<tr>
<td>MNA-SF</td>
<td>-0.143</td>
<td>0.560</td>
</tr>
<tr>
<td>TUG</td>
<td>-0.030</td>
<td>0.904</td>
</tr>
<tr>
<td>10 M Walk Test</td>
<td>0.020</td>
<td>0.935</td>
</tr>
<tr>
<td>Body Fat</td>
<td>-0.239</td>
<td>0.297</td>
</tr>
<tr>
<td>Water Content</td>
<td>0.235</td>
<td>0.333</td>
</tr>
<tr>
<td>Muscle Mass</td>
<td>0.183</td>
<td>0.454</td>
</tr>
<tr>
<td>BMR</td>
<td>0.171</td>
<td>0.483</td>
</tr>
<tr>
<td>Visceral Fat</td>
<td>0.049</td>
<td>0.841</td>
</tr>
<tr>
<td>R Shoulder Flexion</td>
<td>0.018</td>
<td>0.941</td>
</tr>
<tr>
<td>R Shoulder Extension</td>
<td>-0.274</td>
<td>0.255</td>
</tr>
<tr>
<td>R Shoulder Adduction</td>
<td>-0.203</td>
<td>0.404</td>
</tr>
<tr>
<td>R Shoulder Abduction</td>
<td>-0.114</td>
<td>0.642</td>
</tr>
<tr>
<td>L Shoulder Flexion</td>
<td>0.053</td>
<td>0.828</td>
</tr>
<tr>
<td>L Shoulder Extension</td>
<td>0.018</td>
<td>0.943</td>
</tr>
<tr>
<td>L Shoulder Adduction</td>
<td>-0.071</td>
<td>0.773</td>
</tr>
<tr>
<td>L Shoulder Abduction</td>
<td>0.049</td>
<td>0.841</td>
</tr>
<tr>
<td>R Elbow Flexion</td>
<td>0.114</td>
<td>0.644</td>
</tr>
<tr>
<td>R Elbow Extension</td>
<td>-0.717</td>
<td>0.443</td>
</tr>
<tr>
<td>L Elbow Flexion</td>
<td>0.470</td>
<td>0.042</td>
</tr>
<tr>
<td>L Elbow Extension</td>
<td>0.470</td>
<td>0.042</td>
</tr>
<tr>
<td>R Hip Flexion</td>
<td>-0.030</td>
<td>0.923</td>
</tr>
<tr>
<td>R Hip Extension</td>
<td>-0.219</td>
<td>0.368</td>
</tr>
<tr>
<td>R Hip Abduction</td>
<td>-0.029</td>
<td>0.907</td>
</tr>
<tr>
<td>R Hip Adduction</td>
<td>0.135</td>
<td>0.582</td>
</tr>
<tr>
<td>L Hip Flexion</td>
<td>-0.152</td>
<td>0.533</td>
</tr>
<tr>
<td>L Hip Extension</td>
<td>0.148</td>
<td>0.545</td>
</tr>
</tbody>
</table>
Discussion

The present study was undertaken primarily to analyze the trends in frailty status of a cohort of community dwelling elderly, residing in the Dakshina Kannada district of Karnataka state in India over a period of three months. At the same time the strength of association between the change in frailty score and cognition, nutritional status, gait velocity, functional mobility, body mass, and strength were also analyzed. However, of the 22 subjects, the follow up evaluation could only be done for a total of 19 subjects and hence the goals of the study were realigned to investigate the influence of the pandemic induced lockdown and the associated reduction in physical activity on the outcome variables. The sample size at the outset seems inadequate to bring out any meaningful observations, however we decided to proceed with follow-up of subjects in light of the arguments put forth by Indrayan A et al. (2021). As per the arguments a big sample may be required in cases where the variability is high or the event under the study is rare and a precise estimate is required. We assumed that the age related changes would present with minimal variability, and none of the outcomes studied were rare in the studied population as well as none of them required extreme precision of estimation. Under these circumstances it was deemed prudent to persist with the follow-up evaluation of recruited subjects. In the current study we found that there was an observable change in frailty status over a period of three months, but it was not statistically significant.

Frailty is an umbrella term and there are many tools to measure frailty. The EFIP scale was used in the current study because it covers all domains of frailty (physical, psychological, social functioning and general health), and has been proven to have good reliability and validity. The data collection involved administering four questionnaires (EPIF, MOCA, MNA®-SF and PASE) which on an average took 45 minutes to one hour to complete. Objective measures of strength, functional mobility, gait velocity, and body composition analysis would take an additional hour to complete. This made the entire data collection process a time consuming one thereby adversely affecting the number of subjects recruited in a day. However, other than the three subjects who chose to forgo the follow-up evaluation because of the pandemic situation, there were no additional dropouts in the span of the study and no reported discomfort or adverse event pertaining to data collection.

The primary objective of the study was to detect any association between changes in frailty status and other outcome variables. It must be noted that there was only a very minimal difference (over a period of three months) in frailty score (mean difference 0.625) and findings were not statistically significant. We could not find any statistically significant relationship between changes in frailty score and the changes in strength, muscle mass, cognition, nutritional status, gait velocity, or functional mobility.

It must be emphasized that, when the independent variables were compared at baseline and three months follow-up there was a statistically significant difference found in the scores of MOCA, TUG, visceral fat, PASE and muscle mass. The muscle mass and gait velocity showed a marginal but statistically significant reduction, whereas total body fat as well as visceral fat content showed an increment. Cognitive functions as measured by MOCA and gait velocity (implied by an increase in time taken to complete a 10-meter walk test) showed a decline in the above-mentioned period, whereas the time taken to complete TUG had marginally increased. The observed differences in MOCA scores though were never sufficient to imply a cognitive decline. It can be inferred from these findings that a short span of three months has brought about measurable differences in variables which have been previously associated with frailty.

Previous research corroborated our findings in that there is a definitive decline in muscle mass ranging from 2 to 4% annually in older men and women of all ethnicities. There is also a concurrent increase in body fat content averaging about 0.8% within the same time span.

Factors that influence body composition, especially muscle mass include genetic variables, metabolic variables, endocrinological variables, co-morbidities, diet, alcoholism, smoking, as well as gender and ethnicity. It must be emphasized however that physical activity as an independent variable is a strong predictor for loss of muscle mass.
and changes in body composition in the elderly. The data collection of the present study coincided with the period of pandemic enforced restriction and all of the recruited subjects had reported a considerable decline in the amount of physical activity they indulged in the same period. For measuring physical activity, we used PASE and we found a highly significant reduction in physical activity (Mean difference = 43, p < 0.05) over the three-month period. For the study population, the major source of physical activity used to be walking in public places like parks or attending organized social gatherings like yoga and group exercise sessions. Since most of these activities were deemed to be unsafe, especially in the elderly population, there was virtually a complete absence of these activities in the lockdown period.

Our data analysis shows there is a statistically significant decline in functional mobility as measured by TUG with ageing, but it must be emphasized that this decline was barely consequential, and it is safe to assume there was no decline in functional mobility of the studied cohort. Gait velocity showed a statistically significant difference when compared over the three-month period.

In all major muscle groups of lower extremity, there was a significant difference noted in strength, which ranged from a difference of 0.7 kg to 1.5 kg. One of the key associated finding was that the decline in strength of bilateral hip and knee musculature (hip abductors, hip adductors, knee extension of right side and knee extenders, hip flexors, hip extensors and hip adductors on the left side) showed a statistically significant moderate correlation with decline in muscle mass. Previous studies have shown that there is insufficient evidence of a linear relationship between the loss of muscle strength and muscle mass in ageing, though both have been individually established as definitive outcomes of ageing. Other factors affecting muscle strength have been identified as impaired reciprocal inhibition, alteration in rate coding of motor unit activation, as well as changes in metabolic characteristic of muscle fibers. These changes can happen independent of the changes in muscle mass. The changes in muscle strength could then be attributed to the definitive decline in physical activity levels as previously stated, which would have precipitated a deconditioning/reversal effect on muscle strength. In our study cohort, we observed neither a statistically significant nor any amount of change in the nutritional status of the study population as measured by MNA®-SF.

A major limitation in generalization of the findings of present study is that we studied relatively a small sample from one geographical location. Follow up over a longer time period, with repeated outcome evaluation would have given greater clarity on the changes in frailty as well the contributing factors, which could not be done because of the prevailing restrictions. Since the sample size of the current study was small, it was not feasible to statistically analyse the influence of co-morbidities like diabetes and hypertension on frailty in the population studied, which is a major limitation.

Future researchers must emphasis on recruiting larger samples with greater representation from different geographical, socio-economic and vocational strata. Future studies should also have longer follow-up duration with outcome evaluation at multiple time point to identify and analyze the trends in age related changes.

The findings of the current study suggest that, even in the absence of a major change in frailty status in elderly, the individual factors like muscle strength which contribute towards frailty syndrome show a deterioration or decline, over relative shorter time periods, with major shifts in lifestyle and outdoor/social mobility such as in the case of Pandemic induced restrictions. There is a need to explore ways in which these deteriorations can be contained or reversed before they cross a probable critical limit.

Conclusions
Two key findings of this study are that 1) There was a definitive decline in physical activity of the elderly participants within the lockdown period, and 2) There was absolutely no significant change in the frailty status of community dwelling elderly, even in a time period characterized by physical activity restrictions due to the COVID-19 induced lockdown, although some of the independent determinants of frailty showed a decline in the same period. The present study failed to establish any association between frailty and changes in cognitive, functional mobility, body composition, strength, or nutritional factors, during a relatively short span of three months.

Data availability
Underlying data

Data are available under the terms of the Creative Commons Zero “No rights reserved” data waiver (CC0 1.0 Public domain dedication).
Consent
Written informed consent for publication of the participants’ details was obtained from the participants.

References

Open Peer Review

Current Peer Review Status: 

Version 3

Reviewer Report 10 July 2023

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The necessary amendments have been done by the authors and the response to my comments is given.

Hence, I declare I have no further comments to make.

Thank you and warm regards.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Physiotherapy, rehabilitation, yoga, biomechanics, movement therapy, kinesiotherapy, Musculoskeletal, orthopedics, Physical therapy

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 2

Reviewer Report 19 December 2022

https://doi.org/10.5256/f1000research.140831.r157813
It has been noticed that the following points are not corrected (2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13) and neither a justification for the same is given.

1. The sample size is very small. Hence the generalizability of your findings are questionable. Justify how you ensure external validity of your study based on your small study sample.

2. The justification given in discussion section on small sample is not convincing. What was the study duration?

3. What was the source of sample and their selection? From where were they selected? Needs more elaboration.

4. Considering the inclusion and exclusion criteria and the study design with assessment conducted only twice, the sample size is very meagre. Justify this.

5. The exclusion and inclusion criteria are very vaguely written. What about those with hypertension, renal problems, diabetes etc.? Were they all excluded? What about those who were bed ridden?

6. Where was the assessment conducted? In the community? Considering the data being collected during phased unlock.

7. Who did the collection of data?

8. The lock down part in the methodology can be merged with the study setting part.

9. The presentation of the article is not according to STROBE guidelines. Kindly refer the equator network for the same and reframe the methodology.

10. The outcome variables and follow up is very shallowly written. There is no description of any scales or tests. (eg: Lower extremity muscle strength) - which muscles were assessed?

11. What about the scales having a language barrier? How was it managed with scales?

12. The manufacturing details of the equipment/tools used need to be mentioned in brackets.
Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Physiotherapy, rehabilitation, yoga, biomechanics, movement therapy, kinesiotherapy, Musculoskeletal, orthopedics, Physical therapy

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.

Author Response 06 Apr 2023

Shyam Krishnan

1. The sample size is very small. Hence the generalizability of your findings are questionable. Justify how you ensure external validity of your study based on your small study sample.

Response
Our intension was to collect a larger sample at the outset, and the aim was to go for longer follow-up period, however because of the pandemic and associated restrictions, the footfall of elderly subjects to the community outreach centres in Mangalore, where the study was conducted was severely reduced. The recruited period started in March 2020 and was completed by March 2021. The small sample size is a limitation; however the analysis of data has shown evidence of some definitive trends in the variables studied over a period of 3 months.

1. The justification given in discussion section on small sample is not convincing. What was the study duration?

Response: Justification added in discussion. Page 10, 178-185

1. What was the source of sample and their selection? From where were they selected?

Response: Necessary information regarding the same has been added. Page 5, line no: 87-89

1. Considering the inclusion and exclusion criteria and the study design with assessment conducted only twice, the sample size is very meagre. Justify this.

Response: Justification added in discussion. Page 10, 178-185

1. The exclusion and inclusion criteria are very vaguely written. What about those with hypertension, renal problems, diabetes etc.? Were they all excluded? What about those who were bed ridden?

Response: As mentioned in the methodology, independent community ambulation at the time of first assessment was a necessity for inclusion in the study. We didn't exclude subjects with co-morbidities other than those which could severely limit community ambulation at the time of recruitment. Page 5, 97-99

1. Where was the assessment conducted? In the community? Considering the data being collected during phased unlock.

Response: Necessary information regarding the same has been added. Page 5, line no: 87-89

1. Who did the collection of data?

Response: Necessary information added. Page 6, line no: 121-122
1. The lock down part in the methodology can be merged with the study setting part.

**Response:** Necessary Changes done. Page 5, line no: 89-92

1. The presentation of the article is not according to STROBE guidelines. Kindly refer the equator network for the same and reframe the methodology.

**Response:** The article has been framed as per the requirements put forward by the journal, and changes were made as per the suggestions in the editorial review phase, and has been generally compliant with the STROBE guidelines. But as suggested by the respected reviewer, changes have been made to be more adherent to STROBE guidelines.

1. The outcome variables and follow up is very shallowly written. There is no description of any scales or tests. (eg: Lower extremity muscle strength) - which muscles were assessed?

**Response:** Changes have been made, and additional information has been added as per the suggestions of the respected reviewer. page 5, 105-109

1. What about the scales having a language barrier? How was it managed with scales?

**Response:** All of the outcome measures collected were therapist administered and didn't evaluate responses which could be altered by language barrier.

1. The manufacturing details of the equipment/tools used need to be mentioned in brackets.

**Response:** Necessary information has been added in methodology. page 5, 104-109

**Competing Interests:** No competing interests were disclosed.
Justify how you ensure external validity of your study based on your small study sample.

The justification given in discussion section on small sample is not convincing. What was the study duration?

3. What was the source of sample and their selection? From where were they selected? Needs more elaboration

4. Considering the inclusion and exclusion criteria and the study design with assessment conducted only twice, the sample size is very meagre. Justify this.

5. The exclusion and inclusion criteria are very vaguely written. What about those with hypertension, renal problems, diabetes etc.? Were they all excluded? What about those who were bed ridden?

6. Where was the assessment conducted? In the community? Considering the data being collected during phased unlock.

7. Who did the collection of data?

8. The lock down part in the methodology can be merged with the study setting part.

9. The presentation of the article is not according to STROBE guidelines. Kindly refer the equator network for the same and reframe the methodology.

10. The outcome variables and follow up is very shallowly written. There is no description of any scales or tests. (eg: Lower extremity muscle strength) - which muscles were assessed?

11. What about the scales having a language barrier? How was it managed with scales?

12. Authors have assessed the upper and lower extremity strengths but in methodology mention only lower extremity strength.

13. The manufacturing details of the equipment/tools used need to be mentioned in brackets.

14. The abbreviations should be elaborated at the foot end of the tables.

15. In table 2, a few numbers have been superscripted and in red color. If it is sample number then it needs to be mentioned in brackets.

16. Were the associated comorbidities considered in the participants, since these may cause changes in their functional and strength status? The clear inclusion and exclusion criteria may answer this question.

17. The discussion needs to be more elaborately discussed.

18. The limitations should be presented in the last part of the discussion with future recommendations.
19. What are the clinical implications of your study? Add in end part of discussion after future recommendations

20. References 23 and 19 need to be cited in a correct format with all details.

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
No

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Physiotherapy, rehabilitation, yoga, biomechanics, movement therapy, kinesiotherapy, Musculoskeletal, orthopedics, Physical therapy

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.

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Author Response 29 Apr 2022
**Shyam Krishnan**

On behalf of all the Authors, I express my heartfelt gratitude for the valuable observations made by the respective Reviewers. We will try to assimilate the necessary information and edit the manuscript accordingly.

**Competing Interests:** No competing interests were disclosed.

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Author Response 04 Dec 2022
**Shyam Krishnan**
1. The sample size is not matching in abstract (19) and manuscript (22) The mention of 3 drop outs in discussion should be part of results ideally.

**Response:** Since its a longitudinal study, we decided to analyze the data of only those subjects who completed follow-up evaluation after three months, and hence the findings of the study reflect the observations made only in those 19 subjects.

2. The sample size is very small. Hence the generalizability of your findings are questionable. Justify how you ensure external validity of your study based on your small study sample.

**Response:** Our intension was to collect a larger sample at the outset, and the aim was to go for longer follow-up period, however because of the pandemic and associated restrictions, the footfall of elderly subjects to the community outreach centers in mangalore, where the study was conducted was severely reduced. The recruited period started in March 2020 and was completed by March 2021. The small sample size is a limitation, however the analysis of data has shown evidence of some definitive trends in the variables studied over a period of 3 months.

3. What was the source of sample and their selection? From where were they selected? Needs more elaboration

**Response:** Necessary information regarding the same has been added. Subjects were recruited from the various community outreach centers operated by the Department of Physiotherapy, KMC Mangalore, within the Mangalore city limits.

4. Considering the inclusion and exclusion criteria and the study design with assessment conducted only twice, the sample size is very meagre. Justify this

**Response:** As mentioned above the study period coincided with that of COVID 19 induced lockdown and there was general limitation on the out of home mobility of elderly subjects.

5. The exclusion and inclusion criteria are very vaguely written. What about those with hypertension, renal problems, diabetes etc.? Were they all excluded? What about those who were bed ridden?

**Response:** As mentioned in the methodology, independent community ambulation at the time of first assessment was a necessity for inclusion in the study. We didn't exclude subjects with co-morbidities other than those which could severely limit community ambulation at the time of recruitment.

6. Where was the assessment conducted? In the community? Considering the data being collected during phased unlock.

**Response:** As previously mentioned, data was collected from community out reach centers run by the Department of Physiotherapy. These centers operate out of
community halls or other such public facilities and provide outpatient services.

7. Who did the collection of data?

**Response:** Outcome measures were collected by the primary author

8. The presentation of the article is not according to STROBE guidelines. Kindly refer the equator network for the same and reframe the methodology.

**Response:** The article has been framed as per the requirements put forward by the journal, and changes were made as per the suggestions in the editorial review phase, and has been generally compliant with the STROBE guidelines. But as suggested by the respected reviewer, changes have been made to be more adherent to STROBE guidelines

9. The outcome variables and follow up is very shallowly written. There is no description of any scales or tests. (eg: Lower extremity muscle strength) - which muscles were assessed?

**Response:** Changes have been made, and additional information has been added as per the suggestions of the respected reviewer.

10. Authors have assessed the upper and lower extremity strengths but in methodology mention only lower extremity strength.

**Response:** The necessary information has been added

11. The manufacturing details of the equipment/tools used need to be mentioned in brackets

**Response:** The necessary information has been added

12. The abbreviations should be elaborated at the foot end of the tables

**Response:** Changes have been made

13. In table 2, a few numbers have been superscripted and in red color. If it is sample number then it needs to be mentioned in brackets.

**Response:** corrections have been made

14. Were the associated comorbidities considered in the participants, since these may cause changes in their functional and strength status? The clear inclusion and exclusion criteria may answer this question

**Response:** Data regarding the presence of co-morbidities was collected at initial assessment, and only those cases were to be excluded where co-morbidities limited
community ambulation. There is existing evidence to suggest that co-morbidities could have effect on the dependent as well as independent variables of this study, however the sample size was too small to do a subgroup analysis. Since the primary goal was to study the association between changes in frailty status and changes in the independent variables, the presence of co-morbidities would only be a minor confounder in hypothesis testing.

15. The discussion needs to be more elaborately discussed

   **Response:** Due additions have been made

16. The limitations should be presented in the last part of the discussion with future recommendations

   **Response:** As per the suggestion, changes have been made

17. What are the clinical implications of your study? Add in end part of discussion after future recommendations

   **Response:** As per the suggestions, due additions have been done

18. References 23 and 19 need to be cited in a correct format with all details.

   **Response:** Reference 19 pertains to the data set for the current study which is available for verification at OSF. Reference 23 has been corrected.

*Competing Interests:* No competing interests were disclosed.
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