

# Prevalence of frailty syndrome and its associated factors among community-dwelling elderly in East Coast of Peninsular Malaysia

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## Abstract

**Objective:** Frailty is a clinical syndrome with increased risk of poor health outcomes and particularly prevalent in older adults and community population. The study's aim was therefore to determine the prevalence of frailty and its association with sociodemographic and socioeconomic characteristics, health-related status, and anthropometric measurements among community-dwelling older adults.

**Methods:** A total of 279 older adults aged 60 years and above were randomly selected. Respondents were classified as non-frail (<2 criteria) or frail (≥3 criteria) based on the 'phenotype of frailty'. A binary logistic regression was used to determine predictors of frailty.

**Results:** The prevalence of frailty was 18.3%. The frail older adults were positively associated with advanced age, being unmarried, hospitalisation in the previous year, poor self-rated health, and lower body mass index.

**Discussion:** These results give an overview on underlying effects and guiding actions for prevention programmes functioning to reverse and minimise the adverse effects of frailty syndrome.

## Keywords

Prevalence, frailty syndrome, associated factors, community-dwelling older adults

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## Introduction

Frailty is a geriatric clinical syndrome that increased vulnerability to a large number of adverse outcomes including falls, disability, institutionalisation, and mortality resulting from decreased reserve and resistance to stressors due to cumulative declines across multiple physiological systems.<sup>1</sup> The accumulation of impairment in multiple physiological systems becomes increasingly vulnerable to adverse outcomes once the age increases. Frailty syndrome has become increasingly recognised as a major concern for older individuals. It is a silent process in an adult's life and distinct between normal ageing and disability. Fried et al.<sup>1</sup> proposed phenotype of frailty composed of five components: unintentional weight loss, weakness, slowness, low physical activity level, and exhaustion. The presence of three or more components put individuals in frail condition and the presence of none to two components defines as non-frail.

Frailty is a global issue and is expected to become a common problem among senior citizens in Malaysian. Older adults are the most vulnerable group facing this syndrome. The ageing population in Malaysia continuously increases. Hence, this would increase the prevalence of frailty as well. The estimation of older adults population aged 65 years and above in European countries is projected to rise from 18% to 28% of the population in 2060.<sup>2</sup> In 2020, Malaysia is

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expected to experience the population ageing and the number of older adults is estimated to be 11.3% and is projected to increase to 21% in the year 2050.<sup>3</sup> The prevalence of frailty in community-dwelling older adults ranged from 4.0% to 59.1%.<sup>4</sup> The progression of clinical frailty in the older adults is complex. It is not caused by a single factor but commonly affected by numerous factors and can be interrelated or independent of each other. The associated factors that are commonly reported in the literature include female gender, advanced age, living alone, low education level, low income level, poor self-rated health, and having more chronic disease.<sup>1,5–8</sup> Frailty usually results from a combination of problems and is eventually expressed as an overall functional decline.<sup>9</sup>

Identification of factors contributing to frailty syndrome could have implications on educators, health practitioners and policy makers as a guide in terms of assessments, exploring etiologies and predicting factors for developing future planning, intervention, and treatment to the targeted groups. A comprehensive approach to frailty and limitation prevention is thus required that would focus on modifiable individual and environment risk factors before it may reach the serious stage and become a disability. Thus, this study aimed to determine the prevalence and to identify factors associated with frailty among older adults in community-dwelling Kuala Nerus, Terengganu.

## Methods

### *Study sample and recruitment*

Multi-stage proportional and simple random sampling methods were used for selection of the study location and recruitment of the respondents. Terengganu is located in the Peninsular Malaysia. There are seven districts in Terengganu (Besut, Dungun, Hulu Terengganu, Kemaman, Marang, Setiu, and Kuala Terengganu). Kuala Terengganu has the highest older adults population compared to other districts, which was determined by the 2011 Basic Data of Terengganu State. Kuala Nerus is one of the 24 districts in Kuala Terengganu that contained the highest older adults population in Kuala Terengganu consisting of 60 villages covered in four sub-districts (Wakaf Tembusu, Seberang Takir, Tepoh, Bukit Tunggal). Kuala Nerus has a homogeneous populace and the majority was Malays ethnic group. A total of 2542 individuals were sampled from four sub-district and randomly selected using a 'Research Randomizer' application<sup>10</sup> to achieve the required sample size. The minimum sample size required for logistic regression was 250–500 respondents to yield a good estimate and inferences in the presence of multicollinearity and nonlinear predictor functions.<sup>11</sup> Whereas, Hosmer and Lemeshow<sup>12</sup> in the book of 'Applied Logistic Regression' provided basic guidelines for calculation of sample size based on 10 minimum numbers of cases per independent variable [Sample size,

$n = (\text{number of predictors}) \times (10 - 15 \text{ cases per variable})$ ]. This study purposely selects the minimum 10 cases for each variable, considering the total of 25 independent variables that would be analysed and their association with frailty. The total of 250 respondents required in this study fulfils the suggested minimum sample size of logistic regression. This sample size was increased by 20% to compensate for non-response with reasons probably being respondents not at home, refusals, unable to answer, or not found. Thus, a total of 300 respondents were finally included. The number of respondents selected in each sub-district (Wakaf Tembusu, Seberang Takir, Tepoh, Bukit Tunggal) differed depending on the proportion of population size in each sub-district to make sure there is equitable distribution and to avoid any bias that may occur. The response rate for the study was 93%. Any Malaysian citizen 60 years old and older who had permanently resided in Kuala Nerus at least 1 year was included in this study. The exclusion criteria were having auditory or visual deficits that make communication difficult, being wheelchair bound or temporarily or permanently bedridden, suffering from severe sequelae of stroke, with hemiparesia and/or aphasia, and Alzheimer disease. Each participant was required to sign an informed and voluntary consent form if eligible. For respondents who did not meet the inclusion criteria, any person in the household or neighbour who fulfils the inclusion criteria was selected to participate in the study as a substitute to the first identified respondent. Primary caregivers were also involved during interview sessions for those respondents that accompanied and lived with others to ease the process of interview. Those who refused to participate were considered to be dropped out. Respondents were also considered to be dropped out if they were still not available at home during the second time house-to-house visit. Data collection was performed at home and interviewed face-to-face, lasting 45–60 min. An incentive was given to each respondent at the end of the session. The recruitment process took 5 months – June to November 2013. Ethical approval was obtained from the University Research Ethics Committee, University Putra Malaysia (JKEUPM; Reference number: UPM/TNCPI/RMC/1.4.18 JKEUPM).

### *Instruments*

Data were collected by the administration of structured questionnaire, blood pressure measurement, anthropometric assessment, and frailty status determination. A pilot study had been carried out prior to the usage of the questionnaire in this study which confirms its feasibility and validity. It has been conducted among free-living older adults with the same characteristics of the target population. The overall purpose of this pilot study was to evaluate activity such as instrument and sampling procedure to improve evaluation procedure before it is used on a larger scale. The specific feasibility objectives of this study were to assess the length of time to complete all the interview and assessment session and to

assess whether the respondents could understand each question of Rapid Assessment of Physical Activity (RAPA) questionnaire and Fried frailty phenotype assessment components that have been translated in Malay version using forward-backward translation by an expert panel. The test on face validity was applied as it was a new questionnaire when existing questionnaire in English were translated in native language. All participants clearly understood and could give appropriate answers and feedbacks for every question that was asked. The main study was continued with some modifications. Some structured questionnaires have been discarded or modified to address the relevant questions within feasibility. The structured questionnaire was divided into two sections: sociodemographic and socioeconomic characteristics; and health-related status. Fried frailty phenotype has been used to determine frailty status.

**Structured questionnaires.** To associate with frailty syndrome, the two groups of variables were considered. The first sociodemographic and socioeconomic characteristics, with the following variables: age, gender, marital status, education status, living status, household size, employment status, household income, and income sources. The second was health-related status variables: self-report of diseases (diabetes mellitus, heart disease, hypertension, respiratory problems, gastrointestinal problems, renal disease, and arthritis); self-report of geriatric syndromes (poor hearing, poor vision, appetite loss, sleep-related problems, and incontinence); medication use; history of falls; and hospitalisation in the previous year, self-rated health, and smoking status.

**Blood pressure and anthropometric assessment.** Blood pressure was measured by interviewer in duplicate using Blood Pressure Monitor (OMRON, Model HEM 7111-ARM-FZ). Respondents were asked to refrain from smoking and drinking any tea and coffee during the 30 min preceding the measurement to ensure an accurate reading. The classification of blood pressure for older adults is based on the average of two properly measured. The classification of hypertension were <120/80 mmHg (normal); 120–139/80–89 mmHg (prehypertension), 140–159/90–99 mmHg (hypertension stage 1), and  $\geq 160/100$  mmHg (hypertension stage 2).<sup>13</sup>

The anthropometric assessment included body mass index (BMI); body circumferences (waist circumference (WC), mid-upper arm circumference (MUAC), calf circumference (CC)); and body composition (lean body mass, total body fat). A cut-off BMI value of less than 18.5 kg/m<sup>2</sup> and more than 29.9 kg/m<sup>2</sup> indicates underweight and obese, respectively.<sup>14</sup> The Asian population WC cut-off point which was greater than 90 cm for male and greater than 80 cm for female are classified as having abdominal obesity and high risk for getting metabolic syndrome.<sup>15</sup> A cut-off point of MUAC to indicate muscle wasting as previously described with value less than 23.0 cm for male and 22.0 cm for female.<sup>16</sup> A cut-point of CC less than 30.1 cm for male and

27.3 cm for female were considered muscle wasting as developed by Sakinah et al.<sup>17</sup> According to Lee and Nieman,<sup>18</sup> total body fat (%TBF) can be used to determine the nutritional status. A cut-off point less than 5% for male and 8% for female were considered malnourished and more than 25% for male and 32% for female were considered high body fat.

**Fried frailty phenotype.** All five original criteria proposed by Fried et al.<sup>1</sup> were retained for this study: unintentional weight loss, exhaustion, weakness, slowness, and low physical activity. However, the measurements used to define frailty criteria were slightly different and operationalised as follows:

1. Unintentional loss of weight greater than or equal to 4.5 kg or 5% in the previous year,<sup>1</sup> if not possible, unintentional weight loss was identified indirectly (e.g. self-report weight loss, the clothes became too big).
2. Feeling of exhaustion assessed according to two questions from Center for Epidemiologic Studies Depression (CES-D) scale:<sup>19</sup> 'I felt that everything I did was an effort' and 'I could not get going'. The question is asked 'How often in the last week did you feel this way?' It was considered exhausted if the respondents answered 'most of them or almost daily' to any of the following statements.<sup>1</sup>
3. Weakness was defined as mean grip strength of the dominant hand three times using digital handgrip (Charder; Model MG4800). Males and females who cannot carry out the muscle strength test, or who recorded 18.0 kg of grip strength for male (percentile  $\leq 25$ ) and 12.5 kg (percentile  $\leq 25$ ) for female, were classified as positive for grip strength criterion.<sup>20</sup>
4. Slowness was defined as usual walking speed at a distance of 4.6 m. Respondents who could not carry out walking, or who had walking speed recorded at approximately > 7 s (for male with height < 173 cm or female with height < 159 cm) or > 6 s (for male with height > 173 cm or female with height > 159 cm), were classified as positive for walking criterion.<sup>1</sup>
5. Low physical activity level assessed according to self-report of frequency, duration and intensity of usual activities based on the Rapid Assessment of Physical Activity (RAPA) questionnaires (aerobic activities).<sup>21</sup> Respondents who were classified as sedentary or underactive were considered positive for low physical activity level.

Frailty was definitely indicated as meeting three out of five phenotypic criteria. In this study, handgrip strength was used for determining weakness. However, this study does not follow the cut-off point mentioned in the original

reference to avoid overestimation of the prevalence of frailty. It might be suitable to be applied among Caucasian population that probably have a larger body frame compared to Asian population. For the low physical activity, 'Minnesota Leisure Time Activity' questionnaire was usually used. However, in this study, low physical activity was assessed using Rapid Assessment of Physical Activity (RAPA) questionnaire,<sup>21</sup> and low physical activity identified by low scores (score 1 classified as sedentary or score 2 classified as under-active) of the RAPA score. RAPA questionnaires were more general, simple, and suitable for assessment of physical activity level among older adults in Malaysia and has been used in this study;<sup>22</sup> it can capture their level of physical activity by asking them their daily activity routines and leisure time activities. However, 'Minnesota Leisure Time Activity' questionnaire contains the list of specific activity where most of the activities are not really familiar to Malaysian community particularly for older adults population.

### Statistical analysis

The data collected were analysed using IBM SPSS version 20.0. The data were analysed into three levels (univariate, bivariate, and multivariate). In univariate analysis, the cross-tabulation of frequencies (n) and percentages (%) were used to obtain descriptive statistics for categorical variables. It could describe the characteristic of the respondents according to sociodemographic and socioeconomic characteristics, health-related status, and anthropometric indicators. A bi-variant chi-square test (categorical variables) and independent sample t-test (continuous variables) were performed in identified associated factors. Chi-square test and independent t-test were used to compare the non-frail older adults and frail older adults. The tests showed that less than or equal to 5% probability ( $p \leq 0.05$ ) were included into the multivariate model, which was performed by binary logistic regression test. The results were presented as odds ratio (OR) and 95% confidence interval (CI) were calculated. Hosmer and Lemeshow goodness of fit was set at  $> 0.05$ .

## Results

### Subjects characteristics

A total of 279 respondents (n = 118 (42.3%) male and n = 161 (57.7%) female) with a mean age of  $73.32 \pm 6.05$  years (ranging from age 63 to 99) were included in the study. The characteristics of the respondents are presented in Table 1. The majority of the respondents were married (51.3%), stayed with families (82.4%), and had formal education at least primary school education (58.8%). Most of them were unemployed or already retired (83.5%) and depend on others for monetary supports (78.5%). Hypertension (52%) was the

most common reported disease followed by diabetes (20.4%). Whereas for geriatric syndrome, 62.4% reported poor vision and 31.5% experienced loss of appetite. Close to half the respondents (41.9%) perceived their own health status as fair, poor, and very poor. Approximately 60% take medication on a routine basis at least once a week and out of them, 25.8% take multiple medications for at least three drugs and more at one time. About 15.8% history of falls in the previous year has been recorded.

### Prevalence of frailty syndrome

The population sample exposed that prevalence of frailty syndrome was 18.3% with significantly higher prevalence among old older age group (34.2%) compared to those from young older age group (7.7%;  $p < 0.001$ ). The prevalence of frailty was slightly higher among female (18.6%) compared to male (17.8%), with no significant difference. Bivariate analysis revealed that frailty was positively associated with advanced age but not with gender (Table 2). Low physical activity (43.7%) and weakness (25.8%) were the most frequently observed frailty phenotypes. Slowness was reported in 20.8%, exhaustion in 17.6%, and the lowest criterion was unintentional weight loss in 14.3%. Within age group, the old older significantly have higher prevalence for criterion of exhaustion, weakness, slowness, and low physical activity as compared to young older except for unintentional weight loss. Exhaustion was the highest criterion reported by old older and the prevalence was more than doubled compared to young older. Females had a significantly lower walking speed compared with males. It was noted that about three-quarters of those who had slowness were females as compared to only one-quarter who were males ( $p < 0.01$ ).

With regard to sociodemographic, socioeconomic, and health-related status as presented in Table 3, all explanatory variables in binary analysis submitted to multivariate analysis were aged 75 years old or older ( $p < 0.001$ ); being unmarried either single, widowed, or divorced ( $p < 0.001$ ); no formal education ( $p < 0.001$ ); poor hearing ( $p < 0.0007$ ); appetite loss ( $p < 0.005$ ); history of hospitalisation in the previous year ( $p < 0.006$ ); and poor self-rated health ( $p < 0.001$ ). Unemployed variable was excluded from the multivariate model since there were no cases of employed among the frail respondents. The limited numbers in categorical variable may have problems and might have influenced the results of the logistic regression.

The mean of all anthropometric variables for frail respondents was significantly lower compared to non-frail respondents except for height (Table 3). However, only the BMI and lean body mass variables were added into the model due to the presence of multicollinearity between BMI with WC, MUAC, CC, and %TBF. Compared to non-frail, the proportion of frail was highest among respondents with a BMI less than  $18.5 \text{ kg/m}^2$  and lowest among respondents



**Table 1.** Characteristic of the sample.

Sociodemographic and socioeconomic characteristics	n (%)	Health-related status	n (%)
Gender		Self-report diseases <sup>a</sup>	
Male	118 (42.3)	Diabetes	58 (20.8)
Female	161 (57.7)	Heart disease	27 (9.7)
Age group		Hypertension	145 (52.0)
60–74 years	168 (60.2)	Arthritis	32 (11.5)
≥75 years	111 (39.8)	Renal disease	7 (2.5)
Marital status		Respiratory problem	22 (7.9)
Married	143 (51.3)	Gastrointestinal problem	17 (6.1)
Single/widowed/divorced	136 (48.7)	Geriatric syndrome <sup>a</sup>	
Living status		Poor vision	174 (62.4)
Alone	49 (17.6)	Poor hearing	53 (19.0)
Accompanied	230 (82.4)	Chewing problems	73 (26.2)
Household size		Sleep-related problems	46 (16.5)
≤4	185 (66.3)	Appetite loss	88 (31.5)
>4	94 (33.7)	Incontinence	8 (2.9)
Educational level		Medication status	
No formal education	115 (41.2)	No medication	115 (41.2)
Formal education	138 (58.8)	Regular medication	164 (58.8)
Employment status		Number of drugs	
Unemployed/retired	233 (83.5)	No drug	115 (41.2)
Employed	46 (16.5)	1–2 drugs	92 (33.0)
Household income		≥3 drugs	72 (25.8)
<500	122 (43.7)	History of falls and hospitalisation <sup>a</sup>	
500–1499	109 (39.1)	Falls in the previous year	44 (15.8)
≥1500	48 (17.2)	Hospitalisation in the previous year	32 (11.5)
Income source		Self-rated health	
Depend on others	219 (78.5)	Excellent/very good/good	162 (58.1)
Independent	60 (21.5)	Fair/poor/very poor	117 (41.9)
		Smoking status	
		Smoked	42 (15.1)
		Never/Former	237 (84.9)
		Blood pressure assessment	
		Normal blood pressure (<120/80 mmHg)	101 (36.2)
		Hypertension (≥140/90 mmHg)	178 (63.8)

Descriptive data.

Data are shown as number and percentage, n (%).

<sup>a</sup>Respondents may choose more than one answer.

with a BMI of 30 kg/m<sup>2</sup> and above. The percentage of muscle wasting as assessed by MUAC and CC was significantly higher in frail respondents compared to non-frail respondents ( $p < 0.01$ ).

The factors that predict frailty syndrome among the respondents were as follows: aged 75 years old and above ( $p = 0.006$ ), being unmarried ( $p = 0.002$ ), history of hospitalisation in the previous year ( $p = 0.007$ ), poor self-rated health ( $p < 0.001$ ), and lower BMI ( $p = 0.018$ ). The negative B value of BMI suggests an inverse relationship where a lower BMI is associated with a higher risk for frailty syndrome development (Table 4). The relationship of BMI and frailty does not exhibit a U-shape, with a greater frequency of frail only among those in underweight category but not in obese category.

## Discussion

### Prevalence of frailty syndrome

The prevalence of frail older adults obtained in this study was 18.3%. Our prevalence rate for frail state was noticeably higher compared to systemic review observed in 21 studies with overall weighted average prevalence of frailty was 10.7%.<sup>4</sup> The prevalence of frailty among older adults in population studied was much higher than other local studies.<sup>23,24</sup> Similar results are also observed in other Asian countries such as Taiwan (4.9%).<sup>5</sup> Sathasivam et al.<sup>23</sup> evaluated frailty using multidimensional deficit accumulation model (FI), in which frailty score range from 0 to 1 expressed as a ratio from 40 deficits item.<sup>25</sup> On the other hand, the study sample was among older adults who resided in an urban district.

**Table 2.** Prevalence of Fried criteria according to gender and age group.

Frailty syndrome	Gender		Age group		Total (n = 279)
	Male (n = 118)	Female (n = 161)	60–74 (n = 168)	≥75 (n = 111)	
Frailty status					
Non-frail (0–2 criteria)	97 (82.2)	131 (81.4)	155 (92.3)	73 (65.8)	228 (81.7)
Frail (≥3 criteria)	21 (17.8)	30 (18.6)	13 (7.7)	38 (34.2) <sup>a</sup>	51 (18.3)
Fried criteria					
Unintentional weight loss	20 (50.0)	20 (50.0)	18 (45.0)	22 (55.0)	40 (14.3)
Exhaustion	23 (46.9)	26 (53.1)	15 (30.6)	34 (69.4) <sup>a</sup>	49 (17.6)
Weakness	29 (40.3)	43 (59.7)	27 (37.5)	45 (62.5) <sup>a</sup>	72 (25.8)
Slowness	14 (24.1)	44 (75.9) <sup>c</sup>	24 (41.4)	34 (58.6) <sup>b</sup>	58 (20.8)
Low physical activity	56 (45.9)	66 (54.1)	54 (44.3)	68 (55.7) <sup>a</sup>	122 (43.7)

Chi-square test.

<sup>a</sup> $p < 0.001$ , <sup>b</sup> $p < 0.01$ , significant differences between age groups.

<sup>c</sup> $p < 0.01$ , significant differences between genders.

Whereas, the study location in this study was conducted in rural district in the Kuala Nerus. Differences in characteristics between older adults who resided in an urban and rural in terms of socioeconomic and lifestyle might influence the frail prevalence. The other local study by Badrasawi et al.<sup>24</sup> also used Fried criteria to measure frailty in the Klang Valley. However, to measure weakness, that study applied the same cut-off points for the handgrip as proposed by Fried and colleagues.<sup>1</sup> This might over or under-estimate the prevalence of frailty in our Asian population. In addition, a smaller percentage of underweight among the sample (2–3%) failed to demonstrate its association with frailty, in contrast with this study that demonstrated high prevalence of frailty among those in underweight category.

On the other hand, the prevalence of frailty was quite similar to that seen in Asian country carried out in Japan (16.0%)<sup>26</sup> and other international studies conducted in the United States with the prevalence of frailty was 16.0%.<sup>27</sup> Furthermore, in systematic review study in Latin America and Caribbean composed of 29 studies and 43,083 older adults reported average frail was 19.6%.<sup>28</sup> Other studies for individual countries that showed a higher prevalence of frailty compared to this study were found in studies carried out in Canada that present approximately 22.7% were frail, 27.8% for Turkey, and 23.0% for Italy.<sup>29–31</sup> Some literature showed greatly higher frailty prevalence in Chile (42.6%)<sup>32</sup> and in Turkey (39.2%).<sup>9</sup> Frailty prevalence estimates in this study and international countries were disparate and it is difficult to precisely compare the prevalence between different studies due to different geographical, study design, age, gender, characteristic of respondents and heterogeneous of frailty phenotype implementation.<sup>8</sup>

In this study, the most prevalent frailty components were low physical activity followed by weakness, slowness, exhaustion, and unintentional weight loss, each of which have been positively associated with old older except for unintentional weight loss. For gender, among frailty

components, only slowness showed significant difference between male and female gender. Female compared to male have higher prevalence of slowness; about three-quarters among those who had slowness were female while the rest were male. Nearly half of the respondents were sedentary and underactive represented by low physical activity. High prevalence of low physical activity may be associated with unique sample characteristic since majority of them were already retired and unemployed. They usually spend their time with routine daily activities at home. One review study by Sun et al.<sup>33</sup> highlighted the fact that old older were more sedentary than young older and declining pattern of physical activity with age was extensively reported in previous studies.<sup>34,35</sup> Practicing an active lifestyle seems to be difficult among Malaysian in all ages including young generation. However, the reason of practicing sedentary lifestyle might be different between young and old generation. According to Minhat et al.,<sup>36</sup> poor health status, the existence of chronic illness particularly arthritis, absence of family or friend to do the activity together, and non-conducive environment have been identified as a major constraint to do physical exercise among Malaysian older adults.

Weakness assessed by handgrip strength and slowness by walking test have been associated with upper and lower limb muscle wasting, leading to poor physical performance.<sup>37</sup> About one-fourth of this population sample had weakness and slowness, indicating poor physical performance. The poor physical performance among the respondents was relatively high and may be contributed from the sedentary lifestyle or vice versa. Low physical activity level probably declines with ageing associated with low quality of muscle mass<sup>38</sup> and contributed to sarcopenia development.<sup>39</sup> The loss of muscle mass and strength known as sarcopenia is a key feature of frailty. Thus, the higher prevalence of these frail criteria including low physical activity, weakness, and slowness contributed to the high prevalence of frailty syndrome among this population sample.

**Table 3.** Bivariate association of measured variables with frailty (n = 279).

Factor	Non-frail n (%)	Frail n (%)	p-value
Female	131 (57.5)	30 (58.8)	0.983
Age 75 years and above	73 (32.0)	38 (74.5)	<0.001
Single/widowed/divorced	104 (45.6)	39 (76.5)	<0.001
Living alone	36 (15.8)	13 (25.5)	0.149
Household size > 4	79 (34.6)	15 (29.4)	0.581
No formal education	80 (35.1)	35 (68.6)	<0.001
Unemployed	182 (79.8)	51 (100.0)	0.001
Household income < 500	95 (41.7)	27 (52.9)	0.285
Depend on others for monetary support	176 (77.2)	43 (84.3)	0.352
Diabetes	47 (20.6)	11 (21.6)	1.00
Heart disease	20 (8.8)	7 (13.7)	0.412
Hypertension	118 (51.8)	27 (52.9)	1.00
Arthritis	28 (12.3)	4 (7.8)	0.512
Renal disease	4 (1.8)	3 (5.9)	0.117
Respiratory problem	16 (7.0)	6 (11.8)	0.193
Gastrointestinal problem	11 (4.8)	6 (11.8)	0.068
On regular medication	130 (79.3)	34 (20.7)	0.268
Taken 3 drugs and more	54 (23.7)	18 (35.3)	0.199
Poor vision	137 (60.1)	37 (72.5)	0.133
Poor hearing	36 (15.8)	17 (33.3)	0.007
Chewing problem	57 (25.0)	16 (31.4)	0.447
Sleep-related problem	33 (14.5)	13 (25.5)	0.088
Appetite loss	63 (27.6)	25 (49.0)	0.005
Incontinence	5 (2.2)	3 (5.9)	0.164
History of falls in the previous year	34 (14.9)	10 (19.6)	0.536
History of hospitalisation in the previous year	20 (8.8)	12 (23.5)	0.006
Poor self-rated health (fair/poor/very poor)	80 (35.1)	37 (72.5)	<0.001
Current smoking	34 (14.9)	8 (15.7)	1.00
Blood pressure assessment			0.135
Normal blood pressure	87 (38.2)	14 (27.5)	
Hypertension	141 (61.8)	37 (72.5)	
BMI status			<0.001
Underweight (<18.50 kg/m <sup>2</sup> )	11 (4.8)	15 (29.4)	
Normal (18.50–24.90 kg/m <sup>2</sup> )	115 (50.4)	21 (41.2)	
Overweight (25.00–29.99 kg/m <sup>2</sup> )	67 (29.4)	13 (25.5)	
Obese (>30.00 kg/m <sup>2</sup> )	35 (15.4)	2 (3.9)	
Body circumferences			
MUAC (high risk of malnutrition)	23 (10.1)	16 (31.4)	<0.001
CC (high risk of malnutrition)	42 (18.4)	19 (37.3)	0.006
WC (high risk of malnutrition)	104 (45.6)	18 (35.3)	0.235
Body composition			
Too high total body fat (%)	179 (78.5)	29 (56.9)	0.002
Anthropometric characteristics	Mean ± SD	Mean ± SD	
Height (cm)	152.15 ± 8.92	150.45 ± 7.78	0.173
Weight (kg)	58.02 ± 11.87	50.26 ± 11.50	<0.001
Body mass index (kg/m <sup>2</sup> )	25.05 ± 4.71	22.12 ± 4.70	<0.001
Waist circumference (cm)	84.09 ± 12.35	79.06 ± 12.77	0.013
Mid-upper arm circumference (cm)	26.88 ± 3.84	24.73 ± 3.94	0.001
Calf circumference (cm)	31.62 ± 3.54	29.28 ± 3.66	<0.001
Total body fat (%)	19.08 ± 6.75	14.84 ± 5.90	<0.001
Lean body mass (kg)	39.46 ± 8.47	35.43 ± 7.18	0.001

BMI: body mass index; MUAC: mid-upper arm circumference; CC: calf circumference; WC: waist circumference; SD: standard deviation. Independent t-test, Pearson chi-square test statistic and Fisher's exact test p-value reported for all variables.

**Table 4.** Binary logistic regression for frailty syndrome and nine significant variables using ENTER method.

Model <sup>a</sup>	B	Prevalence of frail n (%)	Odds ratio (95% CI)	p-value
<i>Sociodemographic and socioeconomic characteristics</i>				
Age group				
60–74 years	1.19	13 (25.5)	1.00	0.006
≥75 years		38 (74.5)	3.29 (1.41–7.69)	
Marital status				
Married	1.45	124 (54.4)	1.00	0.002
Unmarried (single/widowed/divorced)		104 (45.6)	4.25 (1.68–10.75)	
Educational status				
Formal	0.62	16 (31.4)	1.00	0.157
Not schooling		35 (68.6)	1.85 (0.79–4.36)	
<i>Health-related status</i>				
Poor hearing				
No	0.79	34 (66.7)	1.00	0.082
Yes		17 (33.3)	2.20 (0.91–5.37)	
Appetite loss				
No	0.63	26 (51.0)	1.00	0.126
Yes		25 (49.0)	1.88 (0.84–4.22)	
Hospitalisation in the previous year				
No	1.48	39 (76.5)	1.00	0.007
Yes		12 (23.5)	4.38 (1.50–12.79)	
Self-rated health				
Excellent/very good/good	1.57	14 (27.5)	1.00	<0.001
Fair/poor		37 (72.5)	4.73 (2.04–10.99)	
<i>Anthropometric characteristic</i>				
Body mass index	−0.124	–	0.88 (0.80–0.98)	0.018
Lean body mass	−0.021	–	0.98 (0.92–1.04)	0.465

CI: confidence interval.

Statistical significance at the 0.05 level (two-tailed).

The reference category is 1.00.

<sup>a</sup>Dependent variable: frailty status (non-frail and frail).

### Frailty syndrome–associated factors

The multivariate binary logistic regression analyses identified five predictors of frailty syndrome among older adults community-dwelling in Kuala Nerus, Terengganu. The associated factors related to frailty syndrome are old age, unmarried, hospitalisation in the previous year, poor self-rated health, and lower BMI.

Among the sociodemographic and socioeconomic characteristics, old age consistently demonstrated a positive association with frail, this association was well established and collaborated with previous literatures.<sup>1,40</sup> Ageing itself increases the susceptibility to being frail; however, those who were getting old were not necessary getting frail. The interesting finding in this study was the association between frailty and marital status. Being married or living with a partner shows a negative association with frailty in which it lowers the risk of getting frail; this association has an agreement with previous studies,<sup>6,26,41</sup> but in contrast, study by Eyigor et al.<sup>42</sup> found that married individuals were at risk to be frail. Although this relationship cannot be proved scientifically,

but, being married with the presence of a partner has empirically released the burden of household duties and child care. In this sense, marital status may be considered as a main component of social supports particularly in older adults, and being married has been associated with positive social support and health outcomes. The good relational qualities by giving emotional, instrumental, and information supports give an advantage on health-related status.<sup>43</sup>

Among health-related status variables, those with history of hospitalisation in the previous year and had poor self-rated health increased the risk to be frail. Frailty was associated with hospitalisation, which is in agreement with other studies.<sup>1,33,41</sup> The frail condition is a stressful event and usually characterised with having multimorbidities,<sup>1,32</sup> anorexia,<sup>44</sup> sarcopenia,<sup>1,45</sup> and poor physical functioning<sup>45</sup> that predisposes them to being hospitalised. Chronic diseases redundantly increase the impact to be hospitalised and could primarily be a first reason to hospital admittance and frailty usually being a hidden cause, and some with unknown reasons. Substantial literatures have demonstrated that most of the diseases including diabetes, hypertension, arthritis, and



heart diseases increase the risk of frailty.<sup>1,46</sup> However, our results showed that most of the diseases insignificantly associated with frailty. Our finding may correlate with several variables: old age, underweight BMI, and poor self-rated health, which are predominantly higher among the frail respondents and potentially increased to the number of being hospitalised. Poor self-rated health being the most influential predictor in frail condition. This association supports existing evidence relating poor self-rated health with the occurrence of frailty.<sup>32,47</sup> Low socioeconomic and low social support apparent to be important predictors of poor self-rated health;<sup>48</sup> these features would reflect the common characteristics of frail older adults in this population sample that more likely to being unmarried, lived alone, and unemployed. Likewise, Ebrahimi et al.<sup>49</sup> found those with not feeling lonely had five times higher OR for rating their health as good compared to those with having feeling of loneliness. In this sense, the lack of social ties in terms of contact with family and communities predispose to poor self-rated health and fragility.

In terms of anthropometric characteristic variables, our finding demonstrated the lower BMI to be an influential factor contributed to the risk of frail and supports the theory of frailty syndrome as a wasting disorder.<sup>1,44,50</sup> In addition, in bi-variant analysis, our results showed the frail respondents had lower body composition (lean body mass, body fat) and body circumferences (CC, WC, MUAC) compared to non-frail respondents, which could delineate a characteristic of frail respondents that mostly were thinner and sarcopenic. The U-shaped curve of BMI was found on the risk of frailty<sup>45</sup> and on the risk of mortality<sup>51</sup> which suggests that both wasting disorder and obesity were highly correlated with frailty and mortality. However, our findings only show a correlation between lower BMI and frailty but not for higher BMI. Obesity seems to be not related to frailty in this population sample. Our result presents the mean BMI for non-frail respondents (25.05, SD=4.71), that fall in overweight category, in line with study<sup>50</sup> that demonstrated overweight individuals scattered in BMIs 25.0–29.9 had lowest prevalence of frail. There is some evidence that BMIs in the overweight category are associated with the best overall health particularly in older adults in whom some surplus fat can be used as a store of energy during a critical illness. Thus, the normal BMI is the best one and older adults who are overweight could have advantages when dealing with health problems and frailty as well.

## Conclusion

In conclusion, the prevalence of frailty syndrome was 18.3%. Given factors that influence frail condition such as old age, being unmarried, hospitalisation in the previous year, poor self-rated health, and lower BMI, it is believed that such association also gives various adverse events. Other factors such as low education (no formal education), poor hearing, appetite loss, and lower lean body mass pose

risk to the development of the frailty, suggesting that they are not the most influential factors. As the older adults population size in Malaysia was growing with the greater longevity, the impact of frailty syndrome could not be ignored and neglected. Determining the predictors of frailty syndrome is important in identifying the modifiable risk factors as a guidance for intervention planning. Further study is needed to validate our findings in other large-scale populations of older adults. Also, since our study used the frailty phenotype to identify frailty syndrome, it might be possible in future study to explore and distinguish the other types of frail instruments for assessing frailty syndrome. Frailty syndrome is common among older adults in community, but broad definitions or measurement instruments used to define frailty status results in wide prevalence between studies. This study is not without limitations. First, the nature of cross-sectional design study does not allow the assessment of any cause-effect mechanism. Second, the population sample may not represent an entire population in Malaysia; the study was only conducted in a localised area, which has studied population with particular economic, social characteristic (low socioeconomic status) and mostly with majority of Malay community. Despite these limitations, this study findings, however, provide baseline data and deepen the knowledge of frailty on reversing its adverse outcomes.

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## Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Ethical approval

Ethical approval for this study was obtained from the University Research Ethics Committee, University Putra Malaysia (JKEUPM; Reference number: UPM/TNCPI/RMC/1.4.18 JKEUPM).

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## Informed consent

Written informed consent was obtained from all subjects before the study.

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