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Frailty in the Ibadan study of aging- characterization and association with disability, quality of life and healthcare utilization

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Abstract

Objectives: Variability in the prevalence of frailty in older populations suggests a need for context-specific information about the phenotype. We characterized a frailty phenotype variant in community dwelling Yoruba Nigerians who were aged 60 years or over.

Methods: Cross-sectional analysis of the first of three follow-up waves in a five year prospective study of a household multistage sample of 1595 stroke- and dementia-free persons. We characterized frailty by relying on locally validated tools and the Cardiovascular Health Study (CHS) principle of 'vicious cycle of decline'. The association of frailty with disability, quality of life (QoL) and healthcare utilization was investigated using multivariate logistic regression analyses.

Results: We found a prevalence of 7.3% (95% C. I=5.9-9.0) for the full frail phenotype and 62.1% (95% C. I=59.9-64.3) for the prefrail phenotype. In fully adjusted logistic regression models, frail respondents had approximately two, five and eight times the odds of greater healthcare utilization (O. R=1.8, 95% C. I=1.2-2.7), disability (O. R=5.4, 95% C. I=3.2-9.2) and poor QoL (O. R=8.4, 95% C. I=4.8-14.6) respectively.

Conclusion: The prevalence of frailty in this population is similar to those reported in other surveys. The results suggest that with cohort specific modifications, the risk profile of frailty as originally conceptualised in North Americans is applicable to, and has suggestive evidence of validity in, this sub-Saharan African population.

Keywords: *Frailty syndrome; low income population; frailty index*

Résumé

Objectifs : La variabilité dans la prévalence de fragilité chez les populations âgées suggère un besoin d'information contextuelle-spécifique sur le phénotype. Nous avons caractérisé une variante du phénotype de fragilité chez des Yorouba Nigérians vivant en communauté qui étaient âgés de 60 ans ou plus.

Méthodes : Analyse transversale de la première des trois vagues de suivi d'une étude prospective de cinq ans sur un échantillon aléatoire à plusieurs degrés de ménages constitué de 1595 personnes sans AVC ni démence. Nous avons caractérisé la fragilité en nous basant sur des outils validés localement et sur le principe du 'cycle vicieux de déclin' de l'Étude sur la santé cardiovasculaire (ESC). L'association de la fragilité avec un handicap, la qualité de vie (QV) et l'utilisation des soins de santé a été étudiée en utilisant des analyses de régression logistique multivariée.

Résultats : Nous avons trouvé une prévalence de 7,3% (95% IC = 5,9 à 9,0) pour le phénotype complet fragile et de 62,1% (95% IC = 59,9 à 64,3) pour le phénotype prefragile. Dans les modèles de régression logistique entièrement ajustés, les répondants fragiles présentaient avec environ deux, cinq et huit fois plus de chances d'avoir une plus grande utilisation des soins de santé (OR = 1,8, 95% IC = 1,2-2,7), un handicap (OR = 5,4, 95 % IC = 3,2 à 9,2) et mauvaise qualité de vie (OR = 8,4, 95% IC= 4,8 à 14,6) respectivement.

Conclusion : La prévalence de fragilité dans cette population est similaire à celle rapportée dans d'autres enquêtes. Les résultats suggèrent qu'avec des modifications à cohorte-spécifiques, le profil de risque de fragilité tel que conçu initialement chez les Américains du Nord est applicable à, et offre des preuves évocatrices de validité dans, cette population d'Afrique subsaharienne.

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Mots-clés : *syndrome de fragilité ; population à faible revenu ; index de fragilité*

Introduction

Frailty in older adults is widely acknowledged as a determinant of their wellbeing [1]. Due to numerous definitions of the syndrome, including the Frailty Index (FI)[2] and Survey of Health Ageing and Retirement in Europe Frailty Index (SHARE-FI) [3], there is variability in reported prevalence estimates in diverse populations. Also, the question of whether to consider frailty as a one-dimensional diagnostic entity [4, 5] or a multidimensional construct [6] remains unanswered. Nevertheless, the phenotype perspective [4, 5, 7] (which considers disability as an outcome of frailty) appears to be the more common and most validated definitions of the syndrome [8].

Irrespective of definition, variability in the prevalence of frailty persists across countries and contexts. For example, recent meta-analytic studies of the phenotype suggest that frailty prevalence ranges from 7.4% in Japan [9] to about 10% in Europe and America [10]. Other studies from High Income Countries (HICs) [6, 11] report higher prevalence of frailty in persons living in low socio-economic neighbourhood and among minority ethnic groups.

Epidemiological studies of frailty phenotypes in Low- and Middle-Income Countries (LMICs) are few [12, 13], but growing. Notably, most LMICs studies of frailty have focused on Chinese and South American populations. One prior study [14] of rural South Africans who were aged 40 years or older found prevalence estimates of between 5.4% and 13.2% across nine different variants of the phenotype.

The wide variability in prevalence estimates of frailty phenotypes across definitions, methods of ascertainment, countries and contexts would suggest the need for context specific information. Such data may be derived by applying locally validated tools, ascertainment procedures and context-appropriate interpretations to the globally accepted concept of frailty as a 'vicious cycle of decline'.

In the present study, we aimed to: 1), characterise a frailty phenotype variant among Yoruba Nigerians by relying on the Cardiovascular Health Study (CHS) [7] principle of 'a vicious cycle of decline', and 2), provide evidence of validity of the phenotype by describing association with disability, poor quality of life (QoL) and healthcare utilization.

Methods

Sample selection and recruitment

The Ibadan Study of Ageing (ISA) is a stratified multistage cluster randomised sample derived from eight neighbouring states in predominantly Yoruba-speaking region of Nigeria, with a population of about 25 million people at the time of the study. The details of the selection procedure have been fully described [15, 16]. Up to five calls were made to contact the selected individuals; and there was no replacement for those who could not be contacted or who refused to participate in the study.

The survey was approved by the University of Ibadan/University College Hospital, Ibadan Joint Ethical Review Board. Participants were those who provided consent, mostly verbal (either because of illiteracy or by choice), before interviews were conducted. Baseline assessment were conducted on a total of 2149 respondents in 2003/2004.

The first of three follow-up waves was conducted in 2007. The present report is based on 1862 respondents who were followed-up in 2007. They represent 86.7% of the baseline sample.

Measures

In 2007, face to face interviews were carried out in the homes of participants to assess a range of domains. All instruments used in the ISA were translated into the local Yoruba language (using the iterative back-translation method) and subjected to cultural adaptation.

Operational definition of frailty and its indicators in the ISA.

The assessment of frailty in the ISA was based on published criteria [1, 5, 7, 8, 17] and informed by the specific features of the study protocol (Table 1).

1. As in some previous studies [5, 8, 14], weight loss was defined as Body Mass Index (BMI) of <18.5 kg/m^2.

2. Exhaustion was assessed with the relevant item in the depression module of the World Mental Health Survey version of the WHO Composite International Diagnostic Interview (CIDI) [18]. The item enquires whether respondent felt tired or low in energy nearly every day for several days or in the past two weeks even when they had not been working very hard.

3. Low physical activity was assessed using an item from the International Physical Activity Schedule [19]. Respondents were asked about whether they actively engaged in outdoor activities such as riding a bicycle or doing farm work in the past 30 days. Those who were not engaged in outdoor activities in the past 30 days were categorized as having low physical activity.

4. Slowness was defined, using previously validated gait speed categories in the ISA [20], as gait

speed ≥8.7 seconds for a 4-meter walk or ≥6.52 seconds for a 3-meter walk. Similar to many previous studies [1, 5, 8, 17, 21], we did not measure hand-grip strength as a specific index of muscle weakness.

We determined whether each frailty indicator was present by assigning scores on each of the four features (1= present, 0=absent). The sum of these scores was used in categorizing ISA participants into the different frailty phenotypes for the present study: Frail (3 or 4 components), Pre-frail (1 or 2 components), and Robust (0 components).

Participants with stroke and dementia were excluded in defining frailty as both conditions are frequently associated with motor or functional disability in older people and may preclude performance in some component tasks used for the definition. Stroke was ascertained by self-report of clinician diagnoses while dementia was diagnosed using a standardized two-staged clinical examination [22].

Measurement of associated factors

Functional Disability: The Katz index of independence in activities of daily living (KatzADL) [23] was used to assess the ability of participants to perform ADL independently. We rated participants' functional status by the adequacy of performance of six functions: bathing, dressing, toileting, transferring, feeding and continence.

Instrumental activities of daily living (IADL) was evaluated by the ability of the participants to perform seven functions in the following areas: climbing a flight of stairs, reaching above the head to carry something weighing about 4.5 kg, stooping, gripping small objects with hands, shopping, and activities such as sweeping the floor with a broom or cutting grass.

Each of the activities in the two domains was rated: (1) can do without difficulty; (2) can do with some difficulty; (3) can do only with assistance; (4) unable to do activity. We classified as functionally disabled, any respondent with a rating of 3 or 4 on any item.

Quality of life (QoL): was measured using the WHO QoL instrument (WHOQoL-BREF). The measure contains a total of 26 questions arranged in four domains of physical health, psychological health, social relationships and environment. The domain scores are indicative of an individual's subjective perception of QoL in the corresponding domain. Higher scores denote higher QoL. The mean score of items within each domain is used to calculate the total domain score. In the present study, poor QoL was defined by a total domain score below the lowest quartile in the distribution.

Other baseline measurements

Participants were asked whether, in the past year, they had utilized a health facility for the care of any health condition/s. In the present study, healthcare utilization was defined as visit to a health care facility (out-patient, in-patient, or both) for any personal health concern.

Residence was classified based on the Nigerian census categorization at the time of study. Economic status was estimated using an asset based procedure relevant to developing countries [24]. Use of tobacco and alcohol was categorized, based on self-report, as ever having smoked or not, and ever used alcohol or not. Those who responded in the affirmative to ever using alcohol were further classified into regular (weekly use or more often) or occasional users (less often than weekly use). Social engagement was assessed using items derived from the WHO Disability Assessment Schedule, version 2 [25].

Data analyses

The sample from which frailty was determined in the ISA comprised of 1595 participants who were free of stroke and dementia out of the 1862 who completed full assessments in 2007. The demographic characteristics of those who survived, died, or were censored were compared using Pearson chi-square test, with a Rao and Scott correction [26] to account for the survey design.

Descriptive statistics such as means and standard deviations were used to summarize quantitative variables while frequencies and percentages were used for categorical variables.

Characteristics of the study sample were compared across frail, pre-frail, and robust participants using the chi-squared test or t-test for categorical or continuous variables, respectively. The analyses took account of the stratified multistage sampling procedure and the associated clustering by applying weights as appropriate. We made adjustment for differences between the sample and the total Nigerian population by applying post-stratifications to the target sex and age range.

Subsequently, we conducted logistic regression analyses to explore the cross-sectional association of frailty with disability, healthcare utilization and QoL. We first conducted an unadjusted analysis. Next, we conducted step-wise adjustments (in three models) for factors that might have significantly affected the risk of being frail in our bivariate analyses. In model I, we adjusted for the significant demographic characteristics (age and gender). In model II, we added significant economic

characteristics (economic and marital statuses) to model I, while in model III we added the significant lifestyle factor (alcohol use) to model II.

The results of adjusted analyses are presented as odds ratios (OR's) with 95% confidence intervals (C. I's). All C. I's are adjusted for design effects. All analyses were conducted using STATA version 13.0 [27]. The survey commands in Stata were used to account for the study sampling scheme. A significance level of 0.05 was used throughout the analyses.

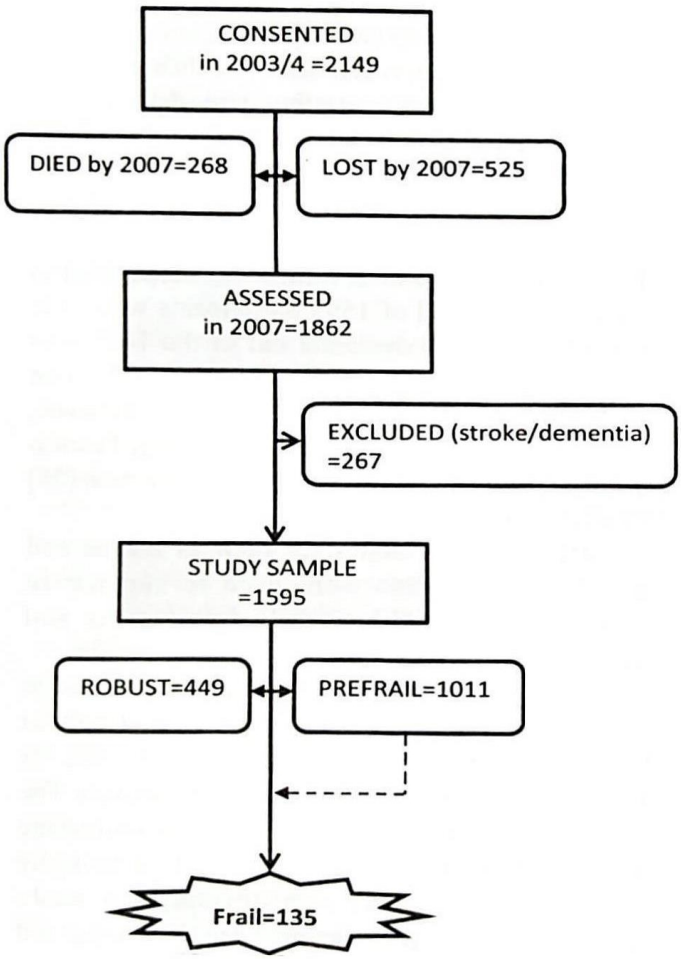

Fig.1: Flow chart of the frailty sample in the Ibadan study of ageing

Results

A total of 525 participants (24.4% of the 2003/4 sample) were lost to follow-up by 2007 (Figure 1). Respondents who were lost to follow-up were more likely to be separated and belong in lower socio-economic positions (Table 2). The mean age of the 2007 sample was 74.8 (± 8.8) years (range= 66 to 84 years). The sample characteristics and frailty indicators are shown in Table 3.

Prevalence of frailty in the ISA

Of the 1595 respondents, 135 (7.3%, 95% C. I=5.9-9.0) were classified as frail while 1011 (62.1%, 95% C. I=59.9-64.3) were pre-frail (Table 4). Table 3 also shows that frail participants were more likely to be older, separated women who belonged in a low economic status and had poor physical functioning and QoL.

Association of frailty phenotypes with adverse health outcomes

Table 4 summarizes the bivariate and multivariable associations of the three phenotypes with adverse health outcomes. In general, there was a dose-response relationship between the number of frailty components in an individual respondent and the risk of adverse health outcomes (Table 5).

Discussion

In this sample of community-dwelling older Nigerians we found a prevalence of 7.3% for the full frail phenotype and 62.1% for the intermediate (prefrail) phenotype at risk of becoming frail. The full frail and prefrail phenotypes were associated with greater odds for poor physical functioning, QoL and use of health care. The odds for adverse health outcomes increased as participants moved from prefrail to the full frail phenotypes.

The prevalence and sizes of associations of our frailty phenotype variants with adverse health outcomes suggest that, with cohort-specific modifications, the risk profile of frailty as conceptualised in older adults from the United States [4, 5, 7] is applicable and valid for community dwelling older adults from SSA. Minor variations in the findings of surveys conducted in different contexts may be due to differences in social, economic and cultural factors affecting understanding, interpretation and reporting of some defining components of the frailty phenotype described in the CHS. As an example, high burden of undernutrition and disease [28] in socio-economically deprived settings may contribute to a higher prevalence of weight loss in studies conducted in such settings, while socio-cultural roles defined by gender in some African communities [29] may affect respondents' understanding and interpretation of some aspects of outdoor physical activities.

Substantial overlaps can also be discerned between the findings of the present study and those conducted in other LMICs [1, 12-14]. Similarities in prevalence and in associated risk factors for adverse health outcomes in studies conducted in

Table 1: Cohort-specific definitions of frailty in the Cardiovascular Health Study, Women's Health Study and Ibadan Study of Ageing

Defining components	Cardiovascular Health Study (N=5317)†	Women's Health Study (N=1002)‡	Ibadan Study of Ageing (N=1595)§
Weight loss	Self-reported weight loss >10 pounds, unintentionally in the past year	BMI <18.5 or e"10% weight loss over the previous H"5 years	BMI<18.5
Exhaustion	*Self-report of any of:* -Low usual energy level (≤3 on a scale of 0-10) -Felt unusually tired in the last month -Felt unusually weak in the past month	*Self-report of either:* -Felt everything I did was an effort in the last week -Could not get going in the last week	Self-report of feeling tired or low in energy low in nearly every day for several days or in the past two weeks even when they had not been workingvery hard.
Low physical activity	Minnesota Leisure time Activity Questionnaire-Short version	Minnesota Leisure time Activity Questionnaire	International Physical Activity Schedule-Short version
Slowness	4 m walk: Speed ≤4.57/7 for a height of ≤159 cm	4.57 m walk: Time ≥7 for a height ≤159	≥8.70 seconds to complete a 4 m
walk or	Speed ≤4.57/6 for a height>159 cm	Time ≥6 for a height >159	≥6.52 seconds for a 3-meter walk
Weakness	Grip strength	Grip strength	Grip strength not measured in the
ISA			
Overall frailty status (%)			
Robust	46.4	33.2	30.6 (95% C. I=28.3-33.1)
Pre-frail	53.3	55.2	62.1 (95% C. I=59.9-64.3)
Frail	6.9	11.6	7.3 (95% C. I=5.9-9.0)

Notes: †Community-dwelling men and women who were 65 years or older, ‡Comprised the most disabled one-third of community dwelling women aged 70-79 years, §Community-dwelling men and women who were 60 years or older .

Table 2: Characteristics of Ibadan study of ageing participants who were followed up from 2003/4 to 2007

Characteristics	Survived N=1862 (%)	Died N=268 (%)	Lost N=525 (%)	Design based F statistic	p-value
Age group, years					
60-64	346 (19.6)	23 (15.3)	91 (19.2)	1.40	0.216
65-69	395 (23.3)	36 (17.6)	113 (23.1)		
70-74	410 (26.0)	54 (27.5)	107 (26.1)		
75-79	359 (20.0)	53 (20.0)	107 (19.8)		
80+	352 (11.2)	102 (19.7)	107 (11.8)		
Gender					
Male	750 (49.3)	132 (56.8)	234 (56.0)	2.93	0.065
Female	1112(50.7)	136 (43.2)	291 (41.0)		
Residence					
Urban	517 (28.0)	80 (33.4)	153 (29.0)	0.45	0.729
Semi-urban	752 (40.5)	100 (37.7)	191 (39.6)		
Rural	593 (31.6)	88 (28.9)	290 (32.6)		
Education, years					
>13	96 (7.8)	28 (8.0)	42 (8.8)	0.81	0.521
7-12	173 (13.7)	33 (12.1)	60 (10.7)		
1-6	329 (24.6)	74 (31.5)	130 (26.3)		
0	758 (53.9)	133 (48.4)	293 (54.3)		
Economic status					
High	203 (13.6)	28 (14.8)	46 (11.7)	4.31	<0.001
High-average	511 (31.3)	53 (28.0)	112 (25.9)		
Low-average	684 (35.4)	82 (25.0)	177 (35.1)		
Low	464 (19.7)	105 (32.3)	190 (27.4)		
Marital status					
Separated†	780 (32.7)	129 (34.6)	283 (41.2)	4.26	0.019
Married	1082 (67.3)	139 (65.4)	242 (58.8)		

†*Separated by death or divorce*

LMICs provide important evidence of reliability for the frailty phenotype variant characterised in the present study.

Due to the unique features of the present study, we have reasons to believe that the 7.3% prevalence of the full frail phenotype reported here, though broadly in agreement with the estimates in the original CHS study [7], is likely to be an underestimation. First, our sample comprised person who were 60 years or older at the time of survey. The reported prevalence of frailty in the literature has tended to increase with the age of the respective survey samples [5]. As an example, we found in the present study that frail respondents were more likely to be older on average than robust persons, being generally over 80 years of age.

Second, considering all previous criteria for defining frailty, we have relied on some of the most restrictive indices. For weight loss, as an example, we used a BMI of less than 18.5 Kg/m^2. Even though the weight loss index in the present study is a popular indicator of undernutrition [28] and may reflect both the historical and empirical realities of the frailty phenotype [30], we think that our reliance on a BMI of less than 18.5 Kg/m^2 may have led to an underestimation of weight loss in our sample. This is because some participants who recorded BMI greater than 18.5 Kg/m^2, may in fact have lost weight unintentionally from a higher weight category. Conversely, self-report of weight loss in the elderly is subject to information bias, especially in relation to the quantitative estimation of the extent of loss.

Third, in our bid to improve the specificity of our definition of frailty in the ISA, we excluded persons with probable dementia and stroke. It is reasonable to expect respondents with stroke or dementia to have motor or functional disability which may confound the classification of respondents as having slowness of movement or low physical activity. Many previous characterizations of frailty have failed to exclude possible causes of slowness of movement or low physical activities [8].

Fourth, the original frailty phenotype-variant proposed in the CHS [7] relied on five defining

Table 3: Characteristics and defining components of frailty in the Ibadan Study of Ageing

Characteristics	Total sample N=1595	Weight loss N=217	Exhaustion N=748	Slowness N=269	Low physical activity N=588
Age group, years					
60-69	467 (30.5)	47 (21.8)	216 (29.2)	53 (24.2)	111 (19.6)
70-79	682 (49.6)	93 (50.2)	326 (51.1)	106 (44.2)	245 (51.1)
80+	446 (19.9)	77 (28.0)	206 (19.8)	110 (31.7)	232 (29.3)
Gender					
Female	942 (50.4)	113 (43.6)	512 (59.8)	174 (54.7)	359 (51.9)
Male	653 (49.6)	104 (56.4)	236 (40.2)	95 (45.3)	229 (48.1)
Residence					
Urban	609 (38.1)	85 (37.8)	271 (35.1)	103 (40.2)	205 (35.2)
Semi-urban	548 (34.6)	72 (33.1)	276 (36.8)	89 (31.8)	221 (36.5)
Rural	438 (27.3)	60 (29.2)	201 (28.1)	77 (28.0)	162 (28.4)
Education, years					
0	633 (54.1)	107 (66.0)	299 (53.7)	117 (57.0)	258 (53.4)
1-6	275 (24.8)	34 (17.4)	135 (25.6)	50 (26.3)	108 (25.0)
≥7	224 (21.1)	29 (16.7)	106 (20.8)	30 (16.7)	94 (21.6)
Economic status					
Low	313 (16.4)	63 (26.6)	145 (17.4)	57 (19.0)	111 (17.0)
Low average	612 (36.8)	86 (40.0)	305 (38.4)	115 (40.8)	251 (41.9)
Higher	670 (46.8)	68 (33.6)	298 (44.1)	97 (40.1)	226 (41.1)
Marital status					
Separated†	657 (32.7)	102 (36.9)	373 (40.2)	134 (37.1)	294 (40.0)
Currently married	938 (67.5)	115 (63.1)	375 (59.8)	135 (62.9)	294(60.0)
Alcohol use					
Never	948 (57.3)	123 (52.6)	480 (61.5)	183 (71.2)	365 (60.0)
Occasional	441 (28.9)	69 (33.8)	192 (27.9)	67 (22.6)	174 (31.4)
Regular‡	183 (13.8)	24 (13.6)	69 (10.7)	17 (6.2)	46 (8.9)
Tobacco smoking					
Never	987 (62.4)	122 (55.6)	491 (65.7)	173 (64.6)	343 (58.0)
Past	448 (29.7)	67 (32.9)	186 (26.5)	70 (27.3)	185 (33.1)
Current	143 (7.9)	27 (11.5)	57 (7.1)	24 (8.1)	56 (8.8)
Social engagement					
Good	1538 (98.4)	203 (95.9)	720 (97.1)	257 (97.6)	559 (96.9)
Poor	41 (1.9)	11 (4.1)	21 (2.1)	10 (2.4)	28 (3.1)
Physical functioning					
Poor	280 (15.0)	49 (20.0)	143 (16.8)	74 (24.1)	192 (31.1)
Good	1315 (85.0)	168 (80.0)	605 (83.2)	195 (75.9)	396 (68.9)
Use of Healthcare					
Yes	752 (50.4)	95 (45.5)	365 (51.8)	132 (53.3)	289 (54.4)
No	827 (49.7)	119 (54.5)	376 (48.2)	134 (46.7)	297 (45.6)
Quality of Life					
Poor	323 (18.7)	52 (18.4)	194 (24.2)	68 (24.3)	214 (37.7)
Good	1215 (81.3)	158 (81.6)	534 (75.8)	192 (75.7)	362 (62.3)

Notes: ‡Regular use of alcohol= ≥ weekly use of a regular measure of alcoholic beverage, Poor physical functioning= Impairment in Activities of Daily Living (ADL)/Instrumental ADL, Poor quality of life= WHO-QoLBREF total domain score in the lowest quartile of the sample distribution. Social engagement=having regular social contacts/participation in family and community activities, †Separated by death or divorce

components. However, as hand-grip strength was not assessed in the ISA, we have relied on four CHS proposed frailty-defining components. The use of a limited number of defining components for the phenotype may reduce the sensitivity of the relevant cohort-defined frailty. In this way, an unintended but systematic underestimation of the burden of frailty in the studied population may result. Nonetheless, the use of four defining components for the frailty phenotypes has been previously proposed for surveys

Table 4: Sample characteristics and frailty status in the Ibadan Study of ageing

Characteristics	Robust N=449 (%)	Pre-frail N=1011 (%)	Frail N=135 (%)	p-value
Mean age (SD), years	73.0 (8.2)	75.6 (9.0)	78.9 (9.8)	<0.001
Female gender	231 (43.9)	612 (52.3)	99 (61.7)	0.008
Rural place of residence	116 (22.9)	288 (30.1)	34 (22.3)	0.075
No formal Education	162 (52.8)	402 (51.4)	69 (65.1)	0.258
Low economic status	78 (13.6)	207 (17.0)	20 (23.6)	0.011
Separated (death/divorce)	129 (23.4)	441 (34.8)	87 (51.7)	<0.001
Regular alcohol use	66 (18.1)	111 (12.9)	6 (4.0)	0.008
Current tobacco smoking	35 (6.7)	94 (8.2)	14 (10.6)	0.799
Poor social engagement	3 (0.6)	31 (2.5)	7 (2.7)	0.063
Poor physical functioning	30 (5.0)	202 (17.8)	48 (33.5)	<0.001
Use of Healthcare	193 (45.6)	488 (52.1)	71 (55.6)	0.121
Poor quality of life	24 (4.3)	249 (23.8)	50 (35.3)	0.001

Note: Regular use of alcohol ≥" weekly use of a regular measure of alcoholic beverage, Poor physical functioning= Impairment in Activities of Daily Living (ADL)/Instrumental ADL, Poor quality of life= WHO-QoLBREF total domain score in the lowest quartile of the sample distribution.

without protocol inclusions for hand-grip strength [1, 5, 8, 17, 21]. Previous findings [31, 32] suggesting that the effect of hand-grip strength on disability and other adverse health outcomes were attenuated (to non-significant thresholds) by the other four CHS frailty-defining components provide additional support for surveys to rely on four components as a meaningful way to characterize frailty.

Where four defining components have been used because of non-inclusion of hand-grip strength, some surveys have attempted to improve sensitivity of cohort-defined frailty phenotype-variant by relying on an alternative interpretation of the CHS frailty-phenotype construct. For example, the requirement for frail respondents to meet criteria for only two (instead of three) defining components have been proposed [1].

Within constraints of the listed caveats, we believe that the findings of this study provide important information that could inform the future research about the nature of frailty among elderly populations in SSA.

Acknowledgments

We would like to thank the data collection team for their work.

Table 5: Cross-sectional association of frailty with disability, poor quality of life, and healthcare utilization

	Poor physical functioning (N=280)			Use of healthcare (N=752)			Poor quality of life (N=323)		
Frailty status	n (%)	O.R (95% C.I)	P-value	n (%)	O.R (95% C.I)	P-value	n (%)	O.R (95% C.I)	P-values
Robust	30 (5.0)	Reference	Reference	193 (45.6)	Reference	Reference	24 (4.3)	Reference	Reference
Pre-frail	202 (17.8)	3.5 (2.3-5.2)†	<0.001	488 (52.1)	1.2 (1.0-1.5)†	0.083	249 (23.8)	5.6 (3.6-8.7)†	<0.001
Model I		3.1 (2.1-4.7)	<0.001		1.3 (1.1-1.7)	0.019		5.2 (3.3-8.0)	<0.001
Model II		3.0 (2.0-4.5)	<0.001		1.3 (1.1-1.7)	0.013		5.2 (3.3-8.0)	<0.001
Model III		2.9 (1.9-4.4)	<0.001		1.4 (1.1-1.7)	0.012		5.1 (3.3-8.0)	<0.001
Frail	48 (33.5)	7.7 (4.6-12.9)†	<0.001	71 (55.6)	1.5 (1.0-2.2)†	0.049	50 (35.3)	10.1 (6.0-17.9)†	<0.001
Model I		6.1 (3.6-10.3)	<0.001		1.8 (1.2-2.6)	0.006		8.8 (5.1-15.2)	<0.001
Model II		5.7 (3.3-9.6)	<0.001		1.8 (1.2-2.7)	0.005		8.7 (5.0-15.2)	<0.001
Model III		5.4 (3.2-9.2)	<0.001		1.8 (1.2-2.7)	0.004		8.4 (4.8-14.6)	<0.001

†*Unadjusted model, Model I=Adjusted for significant demographic factors (age and gender), Model II= Adjusted for significant demographic and economic factors (economic and marital statuses), Model III=Adjusted for significant demographic, economic and lifestyle factors (Alcohol use)*

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