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Original Study

Toward a Comprehensive Model of Frailty: An Emerging Concept From the Hong Kong Centenarian Study



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A B S T R A C T

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Objectives: A better understanding of the essential components of frailty is important for future developments of management strategies. We aimed to assess the incremental validity of a Comprehensive Model of Frailty (CMF) over Frailty Index (FI) in predicting self-rated health and functional dependency amongst near-centenarians and centenarians.

Design: Cross-sectional, community-based study.

Setting: Two community-based social and clinical networks.

Participants: One hundred twenty-four community-dwelling Chinese near-centenarians and centenarians.

Measurements: Frailty was first assessed using a 32-item FI (FI-32). Then, a new CMF was constructed by adding 12 items in the psychological, social/family, environmental, and economic domains to the FI-32. Hierarchical multiple regressions explored whether the new CMF provided significant additional predictive power for self-rated health and instrumental activities of daily living (IADL) dependency.

Results: Mean age was 97.7 (standard deviation 2.3) years, with a range from 95 to 108, and 74.2% were female. Overall, 16% of our participants were nonfrail, 59% were prefrail, and 25% were frail. Frailty according to FI-32 significantly predicted self-rated health and IADL dependency beyond the effect of age and gender. Inclusion of the new CMF into the regression models provided significant additional predictive power beyond FI-32 on self-rated health, but not IADL dependency.

Conclusions: A CMF should ideally be a multidimensional and multidisciplinary construct including physical, cognitive, functional, psychosocial/family, environmental, and economic factors.

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With aging, frailty increases the risk of adverse health outcomes when an individual's diminished strength, endurance, and physiological reserve results in the person's inability to withstand environmental stressors.¹ The consequences of frailty are perhaps the major obstacle to healthy and disability-free life years in old age, while consuming a significant proportion of societal resources.

Clarity on the operational definition and components of frailty is important for clinical care, research, and policy planning. From the many attempts to systematically review the growing numbers of

frailty assessment tools,^{2–4} 2 of the most commonly used validated approaches are (1) the Frailty Phenotype⁵; and (2) the Deficit Accumulation model (Frailty Index, FI).⁶ The Frailty Phenotype is based on 5 clinical criteria indicating the physical manifestation of physiological aging, including excessive weight loss, exhaustion, slow gait speed, weak handgrip, and sedentary behavior.⁵ The FI originally composed of over 70 items indicating cumulative physical and cognitive comorbidities.⁶ More recently, shorter lists of 30–40 variables have been validated, such as the 36-item scale in Song et al⁷ or the 39-item scale by Gu et al,⁸ without loss of predictive power.

The essential components that constitute frailty and how these components interact to exacerbate functional disability, comorbidity, and perceived health status are unresolved. Increasingly, researchers and practitioners are also proposing that frailty should shift its focus from organ- or disease-based approaches toward one that is based upon the well-being of the whole person.^{9–11} Table 1 summarizes the various commonly used frailty assessment tools and their range of core components in the different domains, including physical,

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Table 1
Comparing the Components of the Some Commonly Used Frailty Assessment Tools

Frailty Assessment Scales	Physical Factors (eg, Weight Loss, Fatigue, Slowness, Weakness, Low Activity, Comorbidity)	Functional Factors (eg, Difficulty with Mobility or Self-caring, ADL and IADL Dependency)	Cognitive Factors (eg, Memory Decline, Dementia)	Psychological Factors (eg, Depression, Anxiety, Distress)	Social/Family Factors (eg, Living Alone, Social Activities, Spouse/Children Confidants)	Environmental Factors (eg, Barriers to Activities and Societal engagement)	Economic Factors (eg, Subjective Economic Status)
CHS-FSS ⁵	Yes						
SOF ⁵²	Yes	Yes					
FRAIL-IANA ⁵³	Yes	Yes					
SHARE-FI ⁵⁴	Yes	Yes					
VES-13 ⁵⁵	Yes	Yes	Yes				
CSHA-CFS ⁶	Yes	Yes	Yes	Yes			
CSHA-FI ⁵⁶	Yes	Yes	Yes	Yes	Yes		
GFST ⁵⁷	Yes	Yes	Yes	Yes			
GU ⁸	Yes	Yes	Yes	Yes	Yes		
TFI ³⁰	Yes	Yes	Yes	Yes	Yes		
EFS ⁵⁸	Yes	Yes	Yes	Yes	Yes	Yes	
CFAI ¹⁹	Yes	Yes	Yes	Yes	Yes		
GFI ⁵⁹	Yes	Yes	Yes	Yes	Yes		Yes
CMF (HKCS)	Yes	Yes	Yes	Yes	Yes	Yes	Yes

ADL, activities of daily living; CHS-FSS, Cardiovascular Health Study–Frailty Screening Scale⁵; SOF, Study of Osteoporotic Fractures⁵²; FRAIL-IANA, FRAIL Questionnaire by the International Academy of Nutrition and Aging⁵³; SHARE-FI, Frailty Instrument of the Survey of Health, Ageing and Retirement in Europe⁵⁴; VES-13, Vulnerable Elder Survey-13⁵⁵; CSHA-CFS, Canadian Study of Health and Aging–Frailty⁶; GFST, Gérotopôle Frailty Screening Tool⁵⁷; GU, Gu et al. 2009⁸; TFI, Tilburg Frailty Indicator³⁰; EFS, Edmonton Frail Scale⁵⁸; CFAI, Comprehensive Frailty Assessment Instrument¹⁹; GFI, Groningen Frailty Indicator⁵⁹; CMF (HKCS), Comprehensive Model of Frailty (Hong Kong Centenarian Study).

functional, cognitive, psychological, social/family, environmental, and economic. This list is not exhaustive, and there may be other frailty assessment tools that have not been mentioned here but include some or all of the aforementioned domains.

Centenarians are generally regarded as the sickest and frailest in the society, yet few centenarian studies have explored the concept, components, and consequences of frailty.^{12–15} Duarte et al¹² noted that “those reaching 100 years old are often classified as being noticeably frail; nonetheless, this population has not been included in the majority of contemporary studies on frailty, and to our knowledge, no research has specifically examined the prevalence and the variables associated with frailty among individuals aged 100+”. Our study aimed to examine whether physical, cognitive, functional, psychological, social/family, environmental as well as economic factors converge to form the essential components of frailty, and to assess the incremental validity of a Comprehensive Model of Frailty (CMF) over FI in predicting self-rated health and functional dependency.

Methods

Sampling and Procedures

The Hong Kong Centenarian Study recruited 153 Chinese near-centenarians and centenarians who were born in 1905–1915. Quota sampling method was used according to the proportion of elders aged 85+ of the 18 Geographical Constituency Areas to recruit a geographically representative sample. Eligible elders were recruited based on 2 community social and clinical networks. First, through the Hong Kong Council of Social Service, 628 letters of invitation were sent to day care centers, district elderly community centers, neighborhood elderly centers, social centers for the elderly, home support teams throughout the territory, and the University of the Third Age centers. Two hundred near-and centenarians were reached. Among them, 56 elders participated in the study (participation rate 28%). Second, based on the database of the Elderly Health Clinics of the Department of Health, 210 letters of invitation were sent to eligible elders directly, and 97 of them participated in this study (participation rate 46%). The current study reports on the findings from a subset of 124 participants who were living in the community and not institutionalized. The rest of the 29 participants were institutionalized at the time of the data collection. The original intention of Hong Kong Centenarian Study was to evaluate the health and well-being of community-dwelling near- and centenarians. These 29 participants were initially community-dwelling at the first contact based on the existing databases compiled by the 2 community social and clinical networks but were then institutionalized at the time of sample recruitment and data collection. Considering their special circumstances compared with the 124 community-dwellers, we only included the latter subset in the current analysis. Participants signed written informed consent prior their in-home or center-based face-to-face interviews. At least 1 family member and/or registered social worker were present and witnessed at the consent procedure and the assessment. Because many elders were less familiar with structured interviews and physical examinations, the presence of the family member and/or the social worker was helpful to build a friendly and reassuring environment for the assessment. The assessment protocol was constructed based on 2 validated instruments: the 2008 versions of the Chinese Longitudinal Healthy Longevity Survey and the Elderly Health Center Questionnaire.^{16,17} This study was approved by the Human Research Ethics Committee for Non-Clinical Faculties of the University of Hong Kong in January 2011 (Reference Number: EA200111) and by the Ethics Committee of the Department of Health (Reference Number: L/M 48/2011 in DHHQ/5030/5/5) in May 2011.

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