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FOR DEBATE

Unstable disability and the fluctuations of frailty

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Introduction

Despite increasing use in the literature of old age, 'frailty' remains an ill-defined term. The components of frailty have not been sufficiently defined to be used to identify a research population or a group requiring a public health intervention. It is currently too indefinite a state to be used to identify particular needs in an individual, indeed being 'too frail' may be used to justify investigative and therapeutic nihilism. However, we contend that, properly defined, with the major contributing factors to frailty teased out, it is a useful concept and is the essential component of that important condition of old age—unstable disability.

Frailty and disability

The investigation, treatment and care of elderly people who are both frail and disabled constitutes much of the work of geriatric assessment units but, despite the frequency with which frailty and disability coexist, they are quite separate concepts. Disability indicates loss of function. Frailty indicates instability and risk of loss, or further loss, of function. Disability may arise from a single catastrophic event such as a stroke or traumatic amputation in an otherwise robust individual. After recovery minor, day-to-day fluctuations in function occur [1]: a person with arthritis may perform less well in the cold weather, a person with a stroke may have more spasticity if in pain. Nevertheless, overall function is constant, the disability is stable and the patient may otherwise be in good health.

Unstable disability occurs when function fluctuates markedly with minor external events. Small precipitants, such as a change in drug therapy, cold weather or an attack of bronchitis, produce such a deterioration in performance that independence is threatened. Frailty, as we shall define it, is the root cause of unstable disability and an appropriate focus for prevention, rehabilitation and public health programmes in old age.

Frailty

Frailty is best regarded as 'a condition or syndrome which results from a multi-system reduction in reserve capacity to the extent that a number of physiological systems are close to, or past, the threshold of symptomatic clinical failure. As a consequence the frail person is at increased risk of disability and death from minor external stresses'.

This is consistent with the international classification of impairments, disabilities and handicaps model of single impairment resulting in stable disability [2]. In old age frequent multiple impairments, or frailty, result in unstable disability.

This definition incorporates some previous concepts of frailty: loss of reserve, feebleness and vulnerability [3], the importance of 'small additional deficits' [4], the 'margin of safety' [5] and the presence of abnormalities of physiological function without overt disease necessarily being present [6]. It also incorporates the failure of homeostasis concept in the broad sense used by those who work with older people, rather than in Claude Bernard's original sense applying specifically to the *milieu interieur*.

Existing measurements of frailty

Three types of measurement have been used, but each has difficulties.

Table 1. Characteristics of the key components of frailty

1.	Enable interaction with environment
2.	Influenced by the interaction with environment
3.	Essential for adjustment to stress and damage
4.	Clinical breakdown may be precipitated by minor physical and psychosocial stresses
5.	Impairment may be identified prior to clinical manifestation
6.	Impairment may be corrected
7.	Components are interdependent

Physical performance measures, such as timed walks and chair stands [7], objectively assess function and the capacity of the person to interact with the environment and are useful in predicting disability [8] and death [9]. But they are 'black box' measures which do not give therapeutic direction. Also, impairment may be due to single pathology such as traumatic amputation in an otherwise robust individual.

Measurement of function in multiple different physiological systems is limited because it is difficult to derive a comprehensive score. Also, different systems have varying importance in tasks of independent survival.

Frailty may also be identified by a particular clinical consequence such as frequent falls, incontinence or confusion [10]. There are common risk factors for these conditions [11], which could be regarded as markers of frailty. However, a frail elderly person may be at risk of these problems without yet having fallen or become confused, so they are not sufficiently sensitive to identify a frail population.

Key components of frailty

We have defined frailty as a loss of the person's capability to withstand minor environmental stresses. The interaction of the individual with the environment is central to this concept of frailty. External or environmental stresses precipitate breakdown in a frail person, but these external stresses are also essential for the maintenance of the individual's function [12]. Interventions to improve this capability require the identification of those capacities which are essential for interaction with the environment, can be measured and have the potential for improvement. We suggest that the essential reserve capacities for interaction with the environment are:

(i) musculoskeletal function;
(ii) aerobic capacity;
(iii) cognitive and integrative neurological function;
(iv) nutritional reserve.

The characteristics of these key components of frailty are given in Table 1. These capacities are commonly reduced by disease, illness and age [13], are predictors of loss of function and death [14-16], and can be modified by intervention programmes [17-24].

Diminished reserves in other physiological functions, such as renal function, are also risk factors for mortality and alert the clinician to the need for special care in an individual. We have only included in our model those capacities which are necessary for and maintained by interaction with the environment and which present evidence indicates would be most important in public health programmes of identification and intervention.

Measurement

By using a combination of the more specific physical performance measures and other quantitative assessments [25-28] an overall score can be derived and areas of compromised reserve identified (Table 2). The methods of measurement in Table 2 are a mix of those in which performance is assessed against a population

Table 2. Measures of the components of frailty

Component	Measurement
Musculoskeletal function	Grip strength
	Chair stand (Guralnic *et al.*, 1994) [25]
Aerobic capacity	Sub-maximal treadmill
	6 min walk (Guyatt *et al.*, 1985) [26]
Cognitive/integrative neurological	Mini-Mental State Examination (Folstein *et al.*, 1975) [27]
	Static balance test (Guralnic *et al.*, 1994) [25]
Nutritional state	Body mass index
	Arm muscle area (Campbell *et al.*, 1990) [28]

norm (grip strength) and those which measure reserve capacity directly (treadmill test). Direct measures of reserve capacity are more appropriate to the model of frailty proposed.

Clinical usefulness of the syndrome of frailty

As much as is possible, medical practice is based on a full understanding of pathophysiology and knowledge of the patient's underlying disorders, but lack of that knowledge does not preclude intervention.

We contend that the four key components of frailty require evaluation and intervention while underlying causes are sought and should be treated even if all underlying causes are not identified. In frail elderly people, just treating cause is insufficient. As well as carbimazole and radioactive iodine, the thyrotoxic elderly woman may require an exercise programme to restore muscle bulk and strength and aerobic capacity, nutritional supplements to regain lost weight, and calcium and bisphosphonates to compensate for bone loss.

The use of these four components facilitates:

(i) early and active identification of elderly people at risk of unstable disability;
(ii) attention to underemphasized areas such as nutritional state, strength of the lower limb muscles and balance;
(iii) a comprehensive evaluation so that the interactive, compounding aspects of frailty are identified;
(iv) use of neglected, non-pharmacological interventions such as exercise programmes, dietary supplementation and contact with social clubs.

Measurement of individual aspects of frailty such as nutritional state [28] or cognitive function [29] are useful prognostically; a composite measure may be more so. Identifying the frailty syndrome more accurately may also enable us to determine better those elderly people who will benefit most from geriatric assessment and evaluation units where the expertise to deal with both the acute precipitating event and the underlying components of frailty are readily available.

Preventive programmes have been directed at components of frailty—in particular, physical activity programmes to improve musculoskeletal function [30]. We suggest that a public health approach, in which a raft of measures is directed against the components of frailty in a population of elderly people, is the next step in community preventive programmes.

Research use

The increase in heterogeneity with age makes research findings more difficult to generalize. Knowledge of the frailty of the sample, using standardized measures of the components of frailty should allow better description of the sample, matching of controls and identification of subjects for particular studies. This may be of particular use in drug evaluations where adverse effects are likely to be more common in frail individuals [6].

Recommendations for research

Important research questions follow from this concept of frailty and unstable disability. By measuring the suggested four components of frailty can we more consistently and accurately identify a group of elderly people at risk of unstable disability? Having identified a group of frail elderly people by these measures, does a public health preventive programme addressing deficits in these areas decrease subsequent disability?

We recommend empirical research which demonstrates the syndrome, refines diagnostic criteria, elucidates practical methods of measurement of key physiological capacities and determines how much a formal diagnosis of frailty benefits patient care.

Key points

- Frailty is a syndrome of multi-system reduction in physiological capacity as a result of which an older person's function may be severely compromised by minor environmental challenges, giving rise to the condition of 'unstable disability'.
- Frailty can be diagnosed clinically by measuring four key capacities required for successful interaction with the environment: musculoskeletal function, aerobic capacity, cognitive and integrative neurological function and nutritional state.
- Defining and measuring frailty helps identify an at-risk elderly population who may benefit from public health and individual health maintenance programmes.

References

1. Mulley GP. Principles of rehabilitation. Rev Clin Gerontol 1994; 4: 61-9.

2. World Health Organisation. International Classification of Impairments, Disabilities and Handicaps: a manual of classification relating to the consequences of disease. Geneva: WHO, 1980.

3. Verbrugge LM. Survival curves, prevalence rates and dark matters therein. J Aging Health 1991; 3: 217.

4. Rockwood K, Fox RA, Stolee P, Robertson D, Beattie BL. Frailty in elderly people: an evolving concept. Can Med Assoc J 1994; 150: 489-95.

5. Young A. Exercise physiology in geriatric practice. Acta Med Scand 1986; (suppl. 711): 227-32.

6. Woodhouse KW, Wynne H, Baillie S, James OFW, Rawlins MD. Who are the frail elderly? Quart J Med 1988; 68: 505-6.

7. Guralnik JM, Branch LG, Cummings SR, Curb JD. Physical performance measures in aging research. J Gerontol 1989; 44: M141-6.

8. Guralnik JM, Ferrucci L, Simonsick EM, Salive ME, Wallace RB. Lower extremity function in persons over the age of 70 years as a predictor of subsequent disability. N Engl J Med 1995; 332: 556-61.

9. Williams ME, Gaylord SA, Gerrity MS. The Timed Manual Performance test as a predictor of hospitalization and death in a community based elderly population. J Am Geriatr Soc 1994; 42: 21-7.

10. Winograd CH, Geretz MB, Chung M, Goldstein MK, Dominguez F, Vallone R. Screening for frailty: criteria and predictors of outcome. J Am Geriatr Soc 1991; 39: 778-84.

11. Tinetti ME, Inouye SK, Gill TM, Doucette JT. Shared risk factors for falls, incontinence and functional dependence. JAMA 1995; 273: 1348-53.

12. Bortz WM. The physics of frailty. J Am Geriatr Soc 1993; 41: 1004-8.

13. Buchner DM, Wagner EH. Preventing frail health. Clin Geriatr Med 1992; 8: 1-17.

14. Salive ME, Satterfield S, Ostfeld AM, Wallace RB, Havlik RJ. Disability and cognitive impairment are risk factors for pneumonia-related mortality in older adults. Public Health Rep 1993; 108: 314-22.

15. Wallace JI, Schwartz RS, LaCroix AZ, Uhlmann RF, Pearlman RA. Involuntary weight loss in older outpatients: incidence and clinical significance. J Am Geriatr Soc 1995; 43: 329-37.

16. Galanos AN, Pieper CF, Cornoni-Huntley JC, Bales CW, Fillenbaum GG. Nutrition and function: is there a relationship between body mass index and the functional capabilities of community-dwelling elderly? J Am Geriatr Soc 1994; 42: 368-73.

17. Buchner DM, Beresford SA, Larson EB, LaCroix AZ, Wagner EH. Effects of physical activity on health status in older adults. 11: Intervention studies. Annu Rev Public Health 1992; 13: 469-88.

18. Wilson BA. Dealing with memory problems in rehabilitation. Rev Clin Gerontol 1995; 5: 457-63.

19. Hu MH, Woollocott MH. Multisensory training of standing balance in older adults: 1. Postural stability and one-leg stance balance. J Gerontol 1994; 49: M52-61.

20. Tinetti ME, Baker DI, McAvay G, Claus EB, Garrett P, Gottschalk M *et al.* A multifactorial intervention to reduce the risk of falling among elderly people living in the community. N Engl J Med 1994; 331: 821-7.

21. Rolandelli RH, Ullrich JR. Nutritional support in the frail elderly surgical patient. Surg Clin North Am 1994; 74: 79-92.

22. Bastow MD, Rawlings J, Allison SP. Benefits of supplementary tube feeding after fractured neck of femur: a randomised controlled trial. Br Med J 1983; 287: 1589-92.

23. Delmi M, Rapin CH, Bengoa JM, Delmas PD, Vasey H, Bonjour JP. Dietary supplementation in elderly patients with fractured neck of the femur. Lancet 1990; 335: 1013-6.

24. Woo J, Ho SC, Mak YT, Law LK, Cheung A. Nutritional status of elderly patients during recovery from chest infection and the role of nutritional supplementation assessed by a prospective randomized single-blind trial. Age Ageing 1994; 23: 40-8.

25. Guralnic JM, Simonsick EM, Ferrucci L *et al.* A short physical performance battery assessing lower extremity function: associated with self-reported disability and prediction of mortality and nursing home admission. J Gerontol 1994; 49: M85-94.

26. Guyatt GH, Sullivan MJ, Thompson PJ *et al.* The 6-minute walk: a new measure of exercise capacity in patients with chronic heart failure. Can Med Assoc J 1985; 132: 919-2.

27. Folstein MF, Folstein SE, McHugh PR. 'Mini-Mental State': a practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975; 12: 189-98.

28. Campbell AJ, Spears GFS, Brown JS, Busby WJ, Borrie MJ. Anthropometric measurements as predictors of mortality in a community population 70 years and over. Age Ageing 1990; 19: 131-5.

29. Gale CR, Martyn CN, Cooper C. Cognitive impairment and mortality in a cohort of elderly people. Br Med J 1996; 312: 608-11.

30. Fiatarone MA, O'Neill EF, Ryan ND. Exercise training and nutritional supplemenation for physical frailty in very elderly people. N Engl J Med 1994; 330: 1769-75.

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