Factors contributing to frailty: literature review

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Aim. This paper presents a review of theoretical and research literature in order to identify the factors contributing to frailty.

Background. Frailty is a multifaceted gerontological concept that lacks a clear definition, but may result from an identifiable homogeneous cluster of bio–psycho–social–spiritual factors.

Method. A total of 134 articles were identified through a search of the MEDLINE (1966 to July 2004), CINAHL (1982 to July 2004), PsychInfo (1985 to July 2004) and Ageline (1995 to July 2004) databases. Each article was reviewed to determine its fit with inclusion/exclusion criteria. Seven research and 11 theoretical articles were retained and further reviewed for methodological quality using a validity tool.

Findings. Seventeen different definitions of frailty were identified. Regardless of the differing definitions, common contributing factors could be identified. Physical, cognitive/psychological, nutritional and social factors, as well as ageing and disease, were evident in both the theoretical and research literature.

Conclusions. Although there is strong agreement that a relationship exists between a cluster of factors and frailty, designation of the factors as contributors or outcomes of frailty differs. Without a clear explanatory theory of the path from contributors to frailty to outcomes, research will continue to produce confusing results. A theoretical framework that includes bio–psycho–social–spiritual factors as contributors to frailty is recommended as the most useful framework for gerontological nursing.

Keywords: elder care, frailty, gerontology, literature review, nursing, older people

Introduction

Frailty is one of the greatest gerontological challenges faced by societies with ageing populations in the next 10 years. The World Health Organization (n.d.) states that by the year 2025 there will be 1·2 billion people over the age of 60 years, 75% of those people will be in developing countries (http://www.who.int/ageing/en/). According to Statistics Canada and the United States Census Bureau, those who are 80 years of age and older are the fastest growing population segment in North America (Hetzel & Smith 2000, Health Canada 2003). This phenomenon is not confined to the developed

nations, but rather is occurring in most parts of the world (United Nations 2005). The potential consequence of these changing demographics is a frequent topic of discussion among gerontologists. Frailty, which increases morbidity, mortality, falls and the need for institutional care (Fried *et al.* 2001), may cause an increased strain on all healthcare systems and family structures. Frailty is most prevalent among the old, especially those who are 80 years of age or more (Bowsher *et al.* 1993, Bales & Ritchie 2002). By adversely affecting quality of life for the individual as well as family and friends, frailty diminishes independence in most activities of daily living (ADL) (Hamerman 1999). It is a syndrome that many working in the field of gerontology have difficulty defining. Intensive studies involving large research teams, such as the Canadian Initiative on Frailty and Aging (2003) and the Frailty and Injuries: Cooperative Studies of Intervention Techniques (FICSIT) trials in the United States of America (USA) (Ory *et al.* 1993) are trying to shed some light on the definition of frailty and the best interventions for treating it.

We could not locate a published review that examined the factors contributing to frailty. Identification and integration of these contributing factors from theoretical and empirical definitions would assist gerontological care teams in developing treatment strategies for the frail population. Healthcare workers would be better able to initiate effective strategies to delay or prevent the onset of this syndrome. Policymakers would be better informed when making resource allocation decisions about elder care. In addition, identification of contributing factors would help advance frailty theory and aid in the design of prevention and intervention research programmes.

Aim

The purpose of this review of theoretical and research literature was to integrate factors contributing to frailty. Review papers often include only empirical literature, but we felt it necessary to incorporate theoretical literature to identify concurrence and/or conflict. The research question guiding our review was 'What factors contribute to, or predict frailty'.

Methods

Search strategy

The databases searched were MEDLINE (1966 to July week 1, 2004), CINAHL (1982 to July week 1, 2004), PsychInfo (1985 to July week 1, 2004) and Ageline (1995 to July week 1, 2004). Search terms included various forms of the word frailty in combination with the words predictor or contributing factor. These search terms were used to identify literature discussing factors contributing to frailty rather than literature debating definitions or conceptualizations of frailty itself. The references of retrieved articles were checked to ensure that all relevant articles were reviewed and to ensure a fit with our inclusion criteria. One limitation of this search strategy was the potential elimination of some philosophical and/or sociological literature.

Inclusion criteria

After the databases were searched using pertinent terms, the relevant articles were then examined to determine fit with the inclusion/exclusion criteria. Inclusion criteria for both theoretical and empirical articles were (1) a clear theoretical or operational definition of frailty; (2) clear identification of factors that contributed to, or could predict frailty; and (3) published in English. Exclusion criteria were (1) studies that identified factors that correlated with frailty, but did not specify the direction of the relationship (direction of relationship could be clearly stated, or implied by the statistical methods used); (2) the sample included only elders living in institutions; and (3) studies that were tautologies, i.e. the independent and dependent factors were essentially the same.

The empirical articles were evaluated using a validity tool adapted from Estabrooks *et al.* (2003) to assess robustness of each study. Each article was evaluated on design, sample, measurement and analysis. The highest possible score was 14 and the lowest possible score was 0. It was decided that articles scoring less than five would be eliminated. We did not use a tool to evaluate the theoretical articles.

Results

A total of 134 articles were identified and reviewed by the primary author to determine their fit with the inclusion/exclusion criteria. The final set included seven empirical articles and 11 theoretical articles. The majority of articles retrieved were from medical journals and the rest from other healthcare disciplines such as rehabilitation, nursing and nutrition. The studies were international in range and included the USA, the Netherlands, France and Canada. The concept of frailty was introduced 20 years ago (Hogan *et al.* 2003) and, although no year limit was put on the search, the majority of articles retrieved were published between 1990 and 2001. Exclusion of studies was mainly due to absence of a clear definition of frailty, or failing to define clearly the contributing factors.

Theoretical literature

Identification of the factors contributing to frailty depended on the theoretical framework and definition used by the original investigators. In some theoretical papers, primacy was given to the physiology of the ageing body (Buchner & Wagner 1992), or cellular and system level function (Bortz 1993, 2002, Hamerman 1999, Lipsitz 2002). In other theoretical papers, authors included more holistic aspects, accounting for social and environment factors that contribute to frailty in addition to physiological changes (Rockwood *et al.* 1994, Brown *et al.* 1995, Fried & Walston 1999, Morley *et al.* 2002).

Frailty was defined in 10 different ways in the 11 theoretical articles included. These definitions are summarized in Table 1. Regardless of how frailty was defined, common contributing factors were identified. The three most commonly identified contributing factors were physical inactivity, ageing and disease. Two exceptions were Lipsitz (2002), who identified only age and disease as the factors that contribute to frailty and Hamerman (1999), who identified only disease. Physical factors such as decreased mobility and/or agility (Rockwood *et al.* 1994, Brown *et al.* 1995, Fried & Walston 1999), or decreased physical activity and its consequences (Buchner & Wagner 1992, Bortz 1993, 2002, Raphael *et al.* 1995, Bales & Ritchie 2002, Morley *et al.* 2002), were the most identified contributing factors in the theoretical literature. Nutritional deficits and its consequences were identified in four of the articles (Fried & Walston 1999, Bales & Ritchie 2002, Bortz 2002, Morley *et al.* 2002). Cognitive/psychological factors were identified in four articles (Rockwood *et al.* 1994, Brown *et al.* 1995, Fried & Walston 1999, Morley *et al.* 2002). Socio-economic factors, such as income and education, were identified in three articles (Rockwood *et al.* 1994, Brown *et al.* 1995, Morley *et al.* 2002). Social factors, such as having someone to count on in time of need, were identified in three articles (Rockwood *et al.* 1994, Brown *et al.* 1995, Morley *et al.* 2002). Finally, spiritual, residential and legal factors were identified in two different articles written by one group of authors (Brown *et al.* 1995, Raphael *et al.* 1995).

Empirical literature

Many of the factors identified in the theoretical literature appeared as contributing factors in the empirical literature even though the definitions varied. Empirical definitions are

Table 1 Theoretical literature definitions

Author	Theoretical definition	Operational definition
Bales and Ritchie (2002)	Nutritional frailty is 'an acute, dramatic reduction in appetite as well as food consumption' (p. 312)	
Bortz (1993)	Diminished energy flow (interaction) between the individual and their environment	
Bortz (2002)	'A state of muscular weakness and other secondary widely distributed losses in function and structure' (p. M284)	
Brown *et al.* (1995) Raphael *et al.* (1995)	'A diminished ability to carry out the important practical and social activities of daily living' (p. 95)	
Buchner & Wagner (1992)	'A state of reduced physiological reserve associated with increased susceptibility to disability' (p. 2)	Deficits in the neurological, musculo-skeletal and energy metabolism systems
Fried & Walston (1999)	'A state of age-related physiologic vulnerability resulting from impaired homeostatic reserve and a reduced capacity of the organism to withstand stress' (p. 1389) Sarcopenia Neuroendocrine dysregulation Immune dysfunction	Chronic under nutrition Sarcopenia ↓Resting metabolic rate ↓Walking speed ↓Activity ↓Total energy expenditure ↓Strength and power ↓VO_{2max}
Hamerman (1999)	Is a mid-point between independence and pre-death (p. 945)	
Lipsitz (2002)	Loss of adaptive capacity due to a loss of complexity	
Morley *et al.* (2002)	'A commonly used term indicating older persons at risk for morbidity and mortality' (p. M698)	
Rockwood *et al.* (1994)	'Those in whom the assets maintaining health and the deficits threatening it are in precarious balance' (p. 492)	

given in Table 2. As in the theoretical literature, physical factors and their consequences were the most commonly identified contributing factors, with the exception being Leng *et al.* (2002). Physical inactivity represented by items such as balance, gait or strength was identified as a contributing factor in five of the seven articles (Dayhoff *et al.* 1998, Strawbridge *et al.* 1998, Chin A Paw *et al.* 1999, Brown *et al.* 2000, Fried *et al.* 2001). Disease, whether measured as one specific disease or an accumulation of many diseases, was also found to contribute to frailty in five articles (Strawbridge *et al.* 1998, Chin A Paw *et al.* 1999, Fried *et al.* 2001, Nourhashemi *et al.* 2001, Leng *et al.* 2002). In four studies, cognitive/psychosocial variables were identified as contributing factors (Strawbridge *et al.* 1998, Chin A Paw *et al.* 1999, Fried *et al.* 2001, Nourhashemi *et al.* 2001). In two studies, nutritional issues were identified as contributing to frailty (Strawbridge *et al.* 1998, Nourhashemi *et al.* 2001). Finally, in three studies, socio-economic variables were identified as contributing to frailty (Strawbridge *et al.* 1998, Fried *et al.* 2001, Nourhashemi *et al.* 2001).

Using the validity tool, quality assessment of the seven studies resulted in scores of five or more and so all were determined to be adequate for this review. All the articles included were comparative in design, using cross-sectional techniques to assess diagnostic or predictive ability of a theory or tool. The majority were secondary data analyses performed on large prospective studies with study designs that were appropriate for the purpose and research question(s) stated. Most articles scored lower on the validity tool because frailty was self-reported rather than observed, or the psychometrics of the scale used were not reported. The reliability and validity of some measures were reported in three of the seven empirical articles (Dayhoff *et al.* 1998, Chin A Paw *et al.* 1999, Fried *et al.* 2001). The article that scored the lowest had a small, non-random sample (Dayhoff *et al.* 1998). Sample size ranged from 30 (Leng *et al.* 2002) to 7364 (Nourhashemi *et al.* 2001). Participants for the majority of studies included both men and women, but one included only women (Nourhashemi *et al.* 2001) and one included only men (Chin A Paw *et al.* 1999). Mean age of participants ranged from 73 (Dayhoff *et al.* 1998) to 85 (Leng *et al.* 2002), with the mean age of those diagnosed as frail always being greater than that in the non-frail group. The reported age ranges for the studies were as narrow as 60–88 (Dayhoff *et al.* 1998) and as wide as 65–102 (Strawbridge *et al.* 1998). The reported mean number of chronic diseases/illnesses ranged from two to four. In the majority of studies, frailty was measured as a categorical variable; therefore, techniques such as logistic regression (Strawbridge *et al.* 1998, Chin A Paw *et al.* 1999, Fried *et al.* 2001, Nourhashemi *et al.* 2001) and discriminant analysis (Dayhoff *et al.* 1998) were used in the final analysis. The measurement of frailty and its contributing factors varied throughout the studies, with the majority of researchers focusing on physical aspects.

Integration of theoretical and empirical literature

By reviewing both sets of literature, common contributing factors could be synthesized thereby making the review more relevant for nurses working in the field of gerontology. A cluster of factors identified in both sets of literature will prove useful in advancing our understanding of frailty.

Physical factors were identified in all but four of the 18 articles (Hamerman 1999, Nourhashemi *et al.* 2001, Leng *et al.* 2002, Lipsitz 2002). For the purposes of this paper, physical factors and its outcomes were grouped into two main categories: musculo-skeletal and physical functioning. Musculo-skeletal factors were measured in a variety of ways, including both observable items and questionnaire items. The most frequently measured items were balance (Dayhoff *et al.* 1998, Chin A Paw *et al.* 1999, Brown *et al.* 2000), gait (Chin A Paw *et al.* 1999, Brown *et al.* 2000, Fried *et al.* 2001) and strength (Dayhoff *et al.* 1998, Chin A Paw *et al.* 1999, Brown *et al.* 2000). Different aspects of musculo-skeletal weakness were used by Chin A Paw *et al.* (1999), Fried *et al.* (2001), Leng *et al.* (2002) and Strawbridge *et al.* (1998) in both the operationalization of frailty and as a predictor. Regardless of how they were measured, this group of contributing factors was reported as statistically significant in all studies in which they were included. This finding has great implications for future frailty research. Increasingly, nurses care for ageing clients who are, or will be, frail. Theory and research clearly identifies inactivity leading to musculo-skeletal weakness as a major contributor to frailty.

Physical functioning was the second grouping of physical factors. Functioning was measured as deficit in sensory perception (Brown *et al.* 2000, Nourhashemi *et al.* 2001), difficulties in ADLs or instrumental activities of daily living (IADLs) (Chin A Paw *et al.* 1999, Fried *et al.* 2001, Nourhashemi *et al.* 2001), or reduced mobility/agility (Brown *et al.* 1995, Raphael *et al.* 1995). Disagreement existed between authors who included physical functioning as part of the definition and others who included it as a measurement of frailty. If difficulty in functional tasks is both included in the definition of frailty and identified as contributing to frailty, this results in tautology. There appears to be an important relationship between physical functioning and frailty, but it has yet to be determined if decreased physical functioning contributes to or results from frailty. Clarification is needed

Table 2 Research literature definitions

Author	Theoretical definition	Operational definition
Brown *et al.* (2000)	Difficulty with functional tasks (p. M350)	Based on Modified Physical Performance Test score: book lift, put on and take off a coat, pick up a penny, chair rise, turn 360°, walk 50-ft, one flight of stairs, four flights of stairs, progressive Romberg test (maximum score 36) (1) 32–36 – not frail (2) 25–32 – mild frailty (3) 17–24 – moderate frailty (4) < 17 – excluded
Chin A Paw *et al.* (1999)	'Physical inactivity combined with either low energy intake, 5-year weight loss, or low BMI' (p. 1015)	Physical inactivity – < 210 min/week Low energy intake – < 7·6 MJ per day 5 year weight-loss – > 4 kg Low BMI – < 23·5 kg/m^2
Dayhoff *et al.* (1998)	Frailty is diminished functioning combined with diminished self-rated health (p. 19)	Scoring 21 or more on the World Health Organization Assessment of Functional Capacity combined with a self-report of health as fair or poor • Walking between rooms • Moving around outdoors • Using stairs • Walking at least 1/4 mi • Using the lavatory • Washing and bathing • Dressing and undressing • Getting in and out of bed • Feeding oneself • Cutting toenails • Doing one's one cooking • Doing light housework • Doing heavy housework • Carrying heavy objects • In comparison with other people your age, how would you judge your state of health?
Fried *et al.* (2001)		Prefrail is the presence of 1 or 2 and Frail is the presence of three or more of the following: Shrinking – > 10 lbs lost unintentionally in prior year Weakness – grip strength: lowest 20% (by gender, BMI) Poor endurance and energy – self-reported exhaustion Slowness – walking time/15 feet: slowest 20% (by gender and height) Low physical activity level – kcals/week: lowest 20% (males < 383 kcals/week, females < 270 kcals/week
Leng *et al.* (2002) (using the Fried/Walston definition)	'A wasting syndrome of older adults, characterized by weakness, fatigue, weight loss and extreme vulnerability to stressors, that predicts increased morbidity and mortality' (p. 1268)	(Same as above) 1. Unintentional weight loss of > 10 pounds in the past year 2. Low grip strength by gender and BMI 3. Slow walking speed 4. Subjective exhaustion 5. Low levels of physical activity
Nourhashemi *et al.* (2001)	'A combination of deficits or conditions that arise with increasing age and contribute to making the elderly person more vulnerable to changes in the surroundings and to stress (p. M228)	Disability with one or more IADLs measured by the Instrumental Activities of Daily Living scale

Table 2 (*Continued*)

Author	Theoretical definition	Operational definition
Strawbridge *et al.* (1998)	'A syndrome involving deficiencies in two or more domains involving physical, nutritive, cognitive and sensory capabilities' (p. S9)	Classified as frail if problems/difficulties were reported in two of the following domains: physical functioning • Sudden loss of balance • Weakness in arms • Weakness in legs • Get dizzy or faint when stand up quickly Nutritive Status • Loss of appetite • Unexplained weight loss Cognitive Functioning • Difficulty paying attention • Trouble finding the right works • Difficulty remembering things • Forgetting where put something Sensory Functioning • Vision – difficulty reading a newspaper, recognizing a friend across the street, reading signs at night • Hearing – hearing over the phone, hearing a normal conversation, hearing a conversation in a noisy room. Scores for physical, nutritive and cognitive were 1. rarely or never have a problem in the last 12 months 2. have a little difficulty 3. have some difficulty 4. have a great deal of difficulty Sensory items were scored: 1. have no difficulty 2. have a little difficulty 3. have some difficulty 4. have great difficulty

BMI, basal metabolic rate; IADL, instrumental activities of daily living.

regarding which of the contributing physical factors make the strongest contribution and the most effective intervention methods to prevent or diminish the adverse effects.

The contribution of disease to frailty was identified in 14 of the 18 articles (Buchner & Wagner 1992, Bortz 1993, 2002, Brown *et al.* 1995, Strawbridge *et al.* 1998, Chin A Paw *et al.* 1999, Fried & Walston 1999, Hamerman 1999, Fried *et al.* 2001, Nourhashemi *et al.* 2001, Bales & Ritchie 2002, Leng *et al.* 2002, Lipsitz 2002, Morley *et al.* 2002). Disease was measured as (a) the contribution of various individual diseases (Fried *et al.* 2001, Nourhashemi *et al.* 2001); (b) a summation of the number of diseases (Chin A Paw *et al.* 1999); or (c) chronic low-grade inflammation not resulting from a specific disease (Leng *et al.* 2002). While in both sets of literature authors agree that disease is a strong contributor to frailty, further clarification is needed about which diseases are contributing to it and how they are doing this. Few of the authors writing theoretical literature identified particular diseases; rather they used an overall framework to discuss the role of disease. Identifying whether it is one specific disease, the overall effect of numerous chronic diseases, or an underlying pathological process would greatly advance our understanding of frailty.

Ageing was a predictor of frailty in seven of the 18 articles (Buchner & Wagner 1992, Bortz 1993, Strawbridge *et al.* 1998, Fried & Walston 1999, Fried *et al.* 2001, Nourhashemi *et al.* 2001, Lipsitz 2002). In two studies, ageing was included as an independent predictor but a statistically significant relationship was not found (Dayhoff *et al.* 1998, Leng *et al.* 2002). Although ageing as a contributing factor was not mentioned in all of the articles, the study populations chosen suggest a belief in the existence of a relationship between frailty and ageing. In all of the studies, participants were over the age of 60, implying a relationship between frailty and ageing. The assumption about this relationship must be challenged and further investigated. Clarifying the role of ageing as a contributing factor should be a priority. Theorists must seek clarity about which aspects of ageing are contributing to frailty and researchers must seek concise measurement and testing techniques.

The contribution of cognitive/psychological factors was identified in eight of the 18 articles (Rockwood *et al.* 1994, Brown *et al.* 1995, Strawbridge *et al.* 1998, Chin A Paw *et al.* 1999, Fried & Walston 1999, Fried *et al.* 2001, Nourhashemi *et al.* 2001, Morley *et al.* 2002) and all studies that included these variables found them to be statistically significant contributors to frailty. The contribution of cognition to frailty was assessed using the Mini-Mental State Examination (Chin A Paw *et al.* 1999, Fried *et al.* 2001) and the Pfeiffer test (Nourhashemi *et al.* 2001). Psychological factors, such as depression and self-rated health, were assessed using a questionnaire (Chin A Paw *et al.* 1999, Fried *et al.* 2001, Nourhashemi *et al.* 2001). Fried *et al.* (2001) and Nourhashemi *et al.* (2001) identified cognition as a factor contributing to frailty, while Strawbridge *et al.* (1998) included cognition as part of their operational definition. Dayhoff *et al.* (1998) used the psychological measure of self-rated health as part of their operational definition. While some agreement exists in the literature, further investigation is required to develop a better understanding of what types of cognitive/psychological impairments contribute the most to frailty and how they do this.

Socio-economic factors were discussed in six of the 18 articles (Rockwood *et al.* 1994, Brown *et al.* 1995, Strawbridge *et al.* 1998, Fried *et al.* 2001, Nourhashemi *et al.* 2001, Morley *et al.* 2002). Assessment of these includes items such as level of education (Strawbridge *et al.* 1998, Fried *et al.* 2001, Nourhashemi *et al.* 2001) and income (Fried *et al.* 2001, Nourhashemi *et al.* 2001). None of the authors used socio-economic factors in their definition of frailty. While support can be found in the theoretical and empirical literature for a relationship between socio-economic factors and frailty, there needs to be clarification as to which socio-economic aspects have the strongest relationship with it. Furthermore, how and where nurses can intervene most effectively to buffer the effects of socio-economic status is also needed.

The contribution of malnutrition to frailty was identified in five of the 18 articles (Fried & Walston 1999, Bales & Ritchie 2002, Bortz 2002, Morley *et al.* 2002: Strawbridge *et al.* 1998, Nourhashemi *et al.* 2001). Nutritional status was measured using weight and body mass index (BMI). However, in the majority of studies BMI was not considered to be a contributing factor, but was used in the operationalization of the frailty instead (Strawbridge *et al.* 1998, Chin A Paw *et al.* 1999, Fried *et al.* 2001, Leng *et al.* 2002). Developing the best indicator for malnutrition, as well as clarifying the relationships between sarcopenia, malnutrition and physical activity and their contribution to frailty, is of critical importance.

Social factors were identified in six of the 18 articles (Rockwood *et al.* 1994, Brown *et al.* 1995, Strawbridge *et al.* 1998, Fried *et al.* 2001, Nourhashemi *et al.* 2001, Morley *et al.* 2002). Nourhashemi *et al.* (2001) found that social activities such as taking holidays and participating in senior citizens' clubs had a negative relationship with frailty, while receiving visits from family and friends had a positive relationship. Brown *et al.* (1995) used social involvement as part of their theoretical definition of frailty and identified the unavailability of social support and social activities as a potential contributing factor. Strawbridge *et al.* (1998) found that social isolation as measured by having fewer than three close friends or relatives, or having little contact with friends or family in the past 3 months, predicted frailty. Knowledge of the social factors that contribute to frailty are of particular interest for nurses because it widens the investigatory view and fits with the bio–psycho–social–spiritual foundations of nursing. In both sets of literature there is agreement among authors that social factors contribute to frailty, but this is not consistently assessed or measured, nor is its effect clear.

Discussion

In this review, we have integrated the factors that contribute to frailty as identified in theoretical and empirical definitions. Our inclusion and exclusion criteria allowed for a broad range of theories and research and we were open to the inclusion of any definition as long as it was clearly stated. For example, frailty was defined as a strictly physical syndrome (Chin A Paw *et al.* 1999, Fried *et al.* 2001, Leng *et al.* 2002), as functional difficulty (Brown *et al.* 2000, Nourhashemi *et al.* 2001), as a combination of functional impairment and poor self-rated health (Dayhoff *et al.* 1998) and as a syndrome involving dysfunction in a broad spectrum of domains (Strawbridge *et al.* 1998). Our hope in using this approach was to identify factors, or clusters of factors, that are believed to contribute to frailty. Regardless of the differences in definitions, many of the identified contributing factors were similar, suggesting that a unified definition of frailty is plausible.

Strong support exists for a relationship between many of the identified factors and frailty, but the greatest disagreement lies in the direction or nature of the relationship. Factors identified as contributors to frailty in some articles were used in the operationalization of frailty in other articles. This creates confusion as to which occurs first – frailty or the factor. This problem occurs with the factors of physical functioning, cognition/psychological, social and nutrition. For example, Dayhoff *et al.* (1998) include functional disability in ADLs as part of their operational definition, while others identify

ADL dysfunction as a predictor (Chin A Paw *et al.* 1999, Fried *et al.* 2001, Nourhashemi *et al.* 2001). Clarifying the relational direction is of pressing importance to help achieve conceptual clarity and to focus prevention strategies.

Spirituality, a factor that has been identified as contributing to elders' health and wellbeing (Krause 2002, Meisenhelder 2003) was not included as a possible contributing factor by authors in any of the research studies. Only Brown *et al.* (1995) included spirituality as a factor contributing to frailty in their theoretical framework. Strawbridge *et al.* (1998) chose to use attendance at religious services as an indicator of social activities and found that this was not statistically different between those who were vs. those who were not frail. Considering the potential impact this factor has on elders' health and well-being, it may be useful for future researchers to examine the relationship between frailty and spirituality more closely.

One factor that did not appear in the empirical articles but was often discussed by authors in the theoretical literature is reserve capacity (Woodhouse *et al.* 1988, Buchner & Wagner 1992, Brown *et al.* 1995, Bales & Ritchie 2002, Bortz 2002, Lipsitz 2002). The idea of reserve capacity is present in almost all theoretical or conceptual definitions of frailty, although not all authors are explicit about its inclusion. Reserve capacity is based on the assumption that most organs can sustain a 70% loss of function before failure becomes evident (Bortz 1993, 2002). Reduced ability to adapt due to lack of reserves creates an unstable situation. Campbell and Buchner (1997) take the idea of reserve capacity even further by identifying the specific bodily systems that require a reserve to prevent frailty. According to these authors, reserve capacity is needed in the musculoskeletal, neurological, nutritional and aerobic systems if frailty is to be avoided. Regardless of whether the need for reserve capacity is present in specific body systems, or if it is present in all body systems, most authors included it in their theoretical definition of frailty. Finding a valid and robust measure of reserve capacity will help to clarify its role in frailty.

Increasing awareness of the importance of frailty is occurring amongst those working in the field of gerontology. In this review, by being open to both theoretical and empirical literature, we have identified overlap between theory and research as well as the gaps and differences. Future research differentiating frailty from functional dependence is of critical importance in clarifying contributing factors and relational direction and in advancing frailty theory. In addition, testing of some of the available theories to identify areas of strength and weakness is needed. Although many common factors were identified between the two sets of literature, there is not a large overlap of theories or authors. Many authors who wrote about correlations and relationships between contributing factors and frailty did not clearly identify the theory guiding their research; others proposed a theoretical framework but did not pursue further work. If our understanding of frailty is to move forward, then research must be clearly guided by theory and the theory must be identified when findings are published.

Implications for nursing

Frailty is an increasingly important international issue as many parts of the world experience a demographic shift towards ageing. Nurses in various parts of the world will becoming increasingly exposed to frail adults and therefore require better understanding of frailty, including its contributing factors and outcomes. To understand better the contributing factors, the strengths of available theories must be integrated and any obvious weaknesses be addressed. One of the most comprehensive and useful definitions of frailty for nursing comes from the theoretical papers by Brown *et al.* (1995) and Raphael *et al.* (1995). The theoretical framework set out by these authors reflects the widespread view that frailty is multi-dimensional and has a common cluster of contributing factors. The cluster, which includes physical, cognitive/psychological, socio-economic, nutritional and social factors, as well as disease and ageing, are a reflection of the bio–psycho–social–spiritual view of health. This view is foundational to nursing and therefore the inclusion of more than physical contributing factors makes this theoretical framework a natural fit for nursing. For example, the authors have divided contributing factors into two major categories labelled 'personal' and 'environmental'. These two categories are each further subdivided into four sub-categories: personal into physical, psychological, spiritual and cognitive; and environmental into financial, living situation, legal factors and interpersonal factors. All of these categories are of concern for nursing, with its emphasis on the bio–psycho–social–spiritual nature of our patients.

To test the theoretical framework developed by Brown *et al.* (1995) and Raphael *et al.* (1995), a large case–control design would be useful to clarify which of the contributing factors identified in the framework are significant. In a case–controlled design, the framework would be used to differentiate those who are frail from those who are robust. Then, an exploration of the exposure to each of the contributing factors can be determined. Using a case–control design will help nurses to identify the odds for developing frailty when exposed to the risk factors, therefore increasing our understanding of the 'at-risk' population. Including international

What is already known about this topic

- Frailty is most prevalent in people aged 80 years or more.
- A universal definition of frailty has not been developed.
- Due to the multiple definitions of frailty, identifying factors that contribute to it is difficult.

What this paper adds

- Although many different definitions of frailty exist, common contributing factors can be identified in both the theoretical and research literature.
- Physical factors, ageing and disease are the three main contributing factors.
- Confusion exists about the relational direction between frailty and identified factors.

population samples will help to determine cultural factors that may influence frailty and change the definition of 'at-risk' populations. Identifying the 'at-risk' population is key to early prevention and intervention techniques.

As our patients enter later adulthood, it becomes increasingly important that we are able to differentiate normal ageing from frailty and the framework developed by Brown *et al.* (1995) and Raphael *et al.* (1995) is one that allows nurses to explore frailty without leaving our holistic roots. Medicine has had a strong influence on how frailty is currently conceptualized and a great deal of the existing research on frailty comes from those exploring the biological contributing factors. Nursing, however, has much to contribute to understanding this complex issue. Using this holistic framework will allow us to develop a deeper and more accurate understanding of this emerging gerontological phenomenon.

Author contributions

M-JL, CAE and JCRK were responsible for the study conception and design and drafting of the manuscript. M-JL performed the data collection and data analysis. M-JL obtained funding and M-JL, CAE and JCRK provided administrative support. M-JL and CAE made critical revisions to the paper. CAE and JCRK supervised the study.

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