

# The validity of the Frail instrument in General Practice

by

De Lepeleire J, Ylief M, Stessens J, Buntinx F, Paquay L

---

## Abstract

**Aims:** *The frailty concept is of growing importance. There is a need for the development of a generic instrument to fasten down clinicians' judgment about the autonomy and the degree of frailty of the elderly. It can be a worthwhile tool in the early detection of dementia in primary health care.*

**Methods:** *The validity of the Frail instrument was tested. Out of the Qualidem study population, for 553 persons a Camdex-R score and MMSE are available to test the diagnostic parameters. Second, using data of 845 subjects at home and in the homes for the elderly, validity has been studied by the non linear explorative principal component analysis using Princals.*

**Results:** *The diagnostic parameters of the Frail test in single use and in combination with MMSE for 553 persons are good. Sensitivity is good but specificity is weak. A good Oddsratio is significantly higher when it is used combining Frail with MMSE.*

*The three dimensions of the PRINCALS analysis explained 72% of all variance. The component loadings express the strength of association between each of the items on the one hand and the identified component (i.e. dimension) on the other.*

**Conclusion:** *The Frail instrument has a good diagnostic value. There are strong arguments for a good content validity of the instrument.*

**Keywords:** Frail Elderly, Diagnosis, Dementia

## **Introduction**

The frailty concept is of growing importance and is seen as the chief added value of geriatric medicine (1-5). Frailty can be defined as a physiologic state of increased vulnerability to stressors that results from decreased physiologic reserves, and even dysregulation, of multiple physiologic systems. This decreased reserve results in difficulty maintaining homeostasis in the face of perturbations, whether they are extremes of environmental temperature, exacerbations of a chronic disease, an acute illness, or an injury (6).

In primary care settings, caring for people with chronic and invalidating conditions, the frailty concept is of growing importance (7). The primary care physician needs to adopt a broad 'frailty' concept (8), 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 passed, the threshold of symptomatic clinical failure (2).

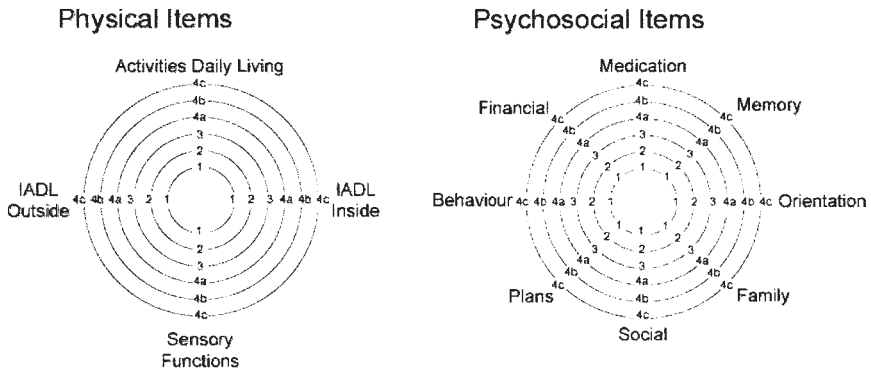
Given this background we developed a generic instrument to fasten down clinicians' judgment about the autonomy and the degree of frailty of the elderly at a somatic, psychological and social level. It is concordance with recently developed guidelines for a new theoretical approach to the concept of frailty in older adults: (a) it must be a multidimensional concept that considers the complex interplay of physical, psychological, social and environmental factors; (b) the concept must not be age-related, suggesting a negative and stereotypical view of ageing; (c) the concept must take into account an individual's context and incorporate subjective perceptions; (d) the concept must take into account the contribution of both individual and environmental factors (9). It must be distinguished from disability and comorbidity (6). It is a clinimetric instrument, aimed to quantify comparative clinical data and personal phenomena of patient care (10-12).

The development of the instrument was based on an earlier published preleminar format (13;14). Further development and validation was performed in a large scaled population study (15).

The Frail instrument (Frail and Autonomy scoring Instrument Leuvan) consists of two concentric circles (figure 1). The first concerns four somatic items: ADL, IADL at home, IADL outside and sensory functions. The second circle concerns eight psycho-social items: the use of medication, memory problems, orientation, family functioning, social functioning, making plans, behaviour and handling finances. For each item

Fig. 1: FRAIL Instrument

**FRAIL: Frail and Autonomy Instrument**



- Score 1: autonomy, no problems
- Score 2: autonomy, with problems
- Score 3: autonomy thanks to help
- Score 4a: dependence but sufficient help
- Score 4b: dependence and uncertain help
- Score 4c: dependence and no help

**Circle 1: Physical domain.** Indicate to what extent the individual is completely autonomous or dependent, or somewhere in between when it comes to:

- Item 1: carrying out daily activities: washing, dressing, personal toilet, continence, eating, moving around the home
- Item 2: Carrying out instrumental activities in the home: cooking, using the telephone, manipulating medication, manipulating money, kitchen activities
- Item 3: Carrying out instrumental activities outside the home: shopping, using public transport, gardening
- Item 4: Physical and sensory function: hearing, seeing, speech, remaining upright and maintaining balance, climbing/ descending stairs

**Circle 2: Psycho-Cognitive-Social domain.** Indicate to what extent the individual is completely autonomous or dependent, or somewhere in between when it comes to:

- Item 1: Manipulating medication; correct use of medication, understanding of use, compliance with medication instructions and ability to use money normally
- Item 2: Managing finances: managing money, understanding of and ability to use money normally
- Item 3: Carrying out memory tasks: e.g. ability to remember names and/or words or to learn new things
- Item 4: Displaying normally adapted behaviour: e.g. without depressive elements, delusions or other problematic behaviour
- Item 5: Orientation in time and space: e.g. remembering what day it is, remembering how to get somewhere, etc.
- Item 6: Making plans and solving problems: autonomy in making and carrying out plans
- Item 7: Developing and maintaining own support network of key persons (partner, children, neighbours)
- Item 8: Developing and maintaining own social network of family, clubs and other community group networks

Allocating a score: the degree of autonomy/dependence

Six scores are available for describing the seriousness of the problems. These scores incorporate two dimensions: the degree of dependence and the availability or lack of help.  
 Score 1: autonomy, i.e. independence without major impedance  
 Score 2: autonomy notwithstanding a degree of impedance\*, which does not lead to any major problems  
 Score 3: autonomy with a degree of handicap\* which is resolved satisfactorily thanks to instrumental help\*\*  
 Score 4a: dependency, but the help \*\* provided is adequate and stable over time  
 Score 4b: dependency and the help offered is only temporary or is inadequate  
 Score 4c: dependency and no help is available

\* make an explicit distinction between:  
 Impedance: where the limitation does not prevent the function from being carried out, al be it with more difficulty  
 Handicap: where the individual is no longer able to perform a function which is normal for their age  
 \*\* Instrumental (score3) is distinguished from help provided (scores 4a to 4c) by the fact that it is limited purely to aids to be used by the individual themselves (e.g. walking stick, personal alarm system, wheelchair), without other persons having to intervene to offer help.

the clinician is asked to mark what his/her idea is about the degree of autonomy and the need for help for each of the items ranging from 1 (autonomous) to 4 (need for help of a third person). A subscore can be calculated for each circle and a total score for both together. In different field trials this new instrument has shown to have a good test-retest reliability as well after two hours as after two weeks (15). It is feasible in general practice, takes three minutes to score and gives the clinician additional information for the planning of the care of chronic and geriatric patients. The internal consistency is good with cronbach alfa measurements varying between.91 and.94. Used for the diagnosis of dementia with the Camdex-N as reference standard (16;17), sensitivity is 0.73(0.52-0.95), specificity is 0.88 (0.80-0.95) and positive likelihoodratio is 6.14 (3.3-11.4) (15;18;19).

In two subanalyses of the Qualidem field trial we looked for the content validity of the Frail instrument understood as the degree to which an instrument fits with the theory behind it (20;21).

## **Methods**

The methodological details are described in the paper of Paquay et al. in this issue. The essential elements are described anyway. The hypotheses tested here is that cognitive deterioration (study 1) and functional decline (study 2), as markers of frailty, can be quantified by the clinimetric instrument Frail.

### *A. General*

#### A.1. Study population

The study population was recruited in two Belgian regions (Lier, Verviers). A broad announcement was launched including repeated postal newsletters, phone calls and personal visits by the investigators. General practitioners (GPs) and independent home care nurses were informed by way of their local professional associations. All home care organizations and residential care facilities were visited by the investigators.

#### A.2. Diagnostic instruments in the selection procedure

A three-stage diagnostic procedure was used. In the first stage, inclusion of eligible subjects was carried out using four basic assessment instruments: the official Belgian ADL evaluation scale (22) an assessment scale

for disruptive behavior, Instrumental Activities of Daily Living (IADL) (23) and the Frail and Autonomy Instrument Leuven (FRAIL) (15). A subject's inclusion score was positive, indicating some degree of dysfunction, if the subject had a positive score for one of six prefixed criteria on the inclusion scales

During the second stage for all subjects with complete inclusion data, the Mini Mental State Examination (MMSE) was administered as a screening instrument for dementia (24).

In the third stage the Cambridge Examination for Mental Disorders of the Elderly – Revised (CAMDEX-R) was used as the final diagnostic reference for all selected subjects. A second informant (e.g. caregiver) for each included patient, was interviewed by the investigators using the CAMDEX-R (25-27).

For the FRAIL instrument a cut-off score  $\leq 19$  was chosen as the minimum score for inclusion.

The maximum score of MMSE is 30 points, indicating excellent cognitive function. A cut-off score  $\leq 23$  was used to select study subjects.

The CAMDEX was designed to provide a formal diagnosis according to operational diagnostic criteria in one of 11 categories. In our study the CAMDEX-R provided support for five diagnostic categories: dementia, delirium, depression, mild cognitive impairment (MCI) or none of these (28).

### A.3. Data management and analysis

Data input was performed manually with MS-Access<sup>®</sup>. The accuracy of data entry was checked by having two different research assistants enter a random sample of 10 % of all available data during the first study stage. The proportion of different data in both databases was 0.33% (25/7,462). Data cleaning, data management and analysis was performed using the SAS System version 8.2 and Statistica (Statsoft, 2000).

## B. Population Study 1

Out of the Qualidem study population, for 553 persons a Camdex-R score and MMSE are available (18). Diagnostic parameters are calculated.

### C. Population Study 2

Using data of people at home and in the homes for the elderly participating the Qualidem study, validity has been studied by the non linear explorative principal component analysis using Princals (29). Frail therefore has been compared with the Belgian Katz instrument and Lawtons' IADL scale. The aim was to explore the underlying structure of the data used for inclusion of study subjects: the Belgian ADL Evaluation Scale (B-ADL), the Belgian Nursing Home Behaviour Scale (BNHBS) and the IADL-scale of Lawton. Factor extracting using non-metric principal components with the PRINCALS algorithm was used. A PRINCALS analysis in three dimensions with all variables treated as ordinal was performed in order to explore the relations between the FRAIL-variables and the variables from the three other assessment instruments used in the inclusion stage of the study: the Belgian ADL Evaluation Scale (B-ADL), the Belgian Nursing Home Behaviour Scale (BNHBS) and the IADL-scale of Lawton. PRINCALS is a data analysis technique which has a strong emphasis on the graphical representation of the relations between the variables (30).

Very low frequency scoring categories were eliminated by merging them with other categories. Therefore the following recoding was used:

FRAIL-items: 6 → 5  
 Lawton's IADL-items: 4 → 3  
 B-ADL (B-ADL\_ORIENTATION SPACE, B-ADL\_ORIENTATION TIME):  
 5 → 4  
 BNHBS-items (BNHBS\_DESTRUCTIVE, BNHBS\_UNDECENT,  
 BNHBS\_VERBAL): 5 & 4 → 3,  
 BNHBS-items (BNHBS\_RESTLESS, BNHBS\_NIGHT,  
 BNHBS\_EXPRESS): 5 → 4

## Results

### *Study 1*

The diagnostic parameters of the Frail test in single use and in combination with MMSE for 553 persons are presented in table 1. Sensitivity is good but specificity is weak. A good Oddsratio is significantly higher when it is used combining Frail with MMSE.

### *Study 2.*

In the home care setting GPs and nurses evaluated 845 persons using these three instruments. The frequency distribution of all variables

TABLE 1  
The diagnostic parameters of FRAIL in single use and in combination with MMSE for 553 persons for the diagnosis dementia in study 1

	Somatic Subscale (95% BI)	Psychosocial Subscale (95%BI)	Frail total scale (95%BI)	MMSE + Frail
<b>Cut Off point</b>	Somscore>18	Somscore>18	Somscore>18	Score Frail >18 and MMSE score ≤ 23
<b>Number of positive scoring subjects</b>	<b>36</b>	<b>441</b>	<b>525</b>	<b>413</b>
<b>SENSITIVITY</b>	0,08 (0.05-0.10)	0,88 (0.84-0.92)	0,93 (0.88-0.98)	0.85 ( 0.92-0.99)
<b>SPECIFICITY</b>	0,99 (0.99-1.00)	0,60 (0.51-0.69)	0,27 (0.20-0.33)	0.91 (0.89-0.93)
<b>ODDS RATIO</b>	15,39 (4.74-50.03)	11,18 (7.09-17.63)	5,12 (2.24-11.71)	56 ( 34,79-90,15)
<b>Positive Predictive Value</b>	0,92 (0.83-1.00)	0,63 (0.55-0.71)	0,50 (0.45-0.54)	0.88 (0.85-0.91)
<b>Negative Predictive Value</b>	0,58 (0.55-0.61)	0,87 (0.82-0.91)	0,84 (0.72-0.95)	0.89 (0.84-0.03)
<b>Likelihood Ratio positive</b>	14,28 (4.42-46.09)	2,21 (1.76-2.78)	1,28 (1.15-1.42)	9.21 (7.18-11.83)
<b>Likelihood Ratio negative</b>	0,93 (0.90-0.95)	0,20 (0.14-0.28)	0,25 (0.12-0.54)	0.16 (0.12-0.23)

TABLE 2  
Frequencies of scores of the items/variables of the inclusion scales

Variable	Missing Categories	1	2	3	4	5	6
FRAIL_DAILY ACTIVITIES		1	996	637	514	2144	155
FRAIL_FINANCIAL		1	1158	483	534	2078	193
FRAIL_BEHAVIOUR		1	1660	775	468	1395	148
FRAIL_MEMORY		1	1358	841	517	1498	232
FRAIL_IADL_INSIDE		1	729	634	594	2279	210
FRAIL_IADL_OUTSIDE		2	502	500	524	2631	288
FRAIL_SENSES		2	1009	860	778	1610	188
FRAIL_MEDICATION		1	1231	444	532	2120	119
FRAIL_ORIENTATION		2	1749	678	436	1413	169
FRAIL_PLAN		0	1252	628	444	1856	267
FRAIL_SOCIAL		2	1434	662	504	1577	268
FRAIL_FAMILY		2	1596	685	478	1470	216
LAWTON_SHOPPING		0	596	1622	2229		
LAWTON_FINANCES		1	1209	1365	1872		
LAWTON_HOUSEKEEPING		0	206	1658	2583		
LAWTON_FOOD PREPARATION		0	771	1292	2384		
LAWTON_MEDICATIONS		0	1330	1817	1300		
LAWTON_TELEPHONE		0	1776	1318	1353		
LAWTON_TRANSPORTATION		0	855	2350	1242		
LAWTON_LAUNDRY		0	576	1207	2664		
B-ADL_CONTINENCE		0	2040	1057	788	562	
BNHBS_DESTRUCTIVE		0	3634	616	197		

B-ADL_EATING	0	2283	1389	494	281
B-ADL_CLOTHING	1	1574	451	830	1591
BNHBS_NIGHTLY BEHAVIOUR	0	3154	767	320	206
BNHBS_UNDECENT	0	3307	701	439	
B-ADL_ORIENTATION SPACE	4	2240	851	741	611
B-ADL_ORIENTATION TIME	0	2053	933	804	657
BNHBS_RESTLESS	0	2841	955	466	185
B-ADL_TOILETING	0	2334	608	1244	261
BNHBS_EXPRESS	0	2530	967	515	435
BNHBS_VERBAL BEHAVIOUR	0	3305	753	389	
B-ADL_TRANSFER	1	1787	1217	796	646
B-ADL_WASHING	3	1245	468	1024	1707

TABLE 3

Component loadings of scale items on three dimensions of the PRINCALS analysis

Items	Dimension 1	Dimension 2	Dimension 3
FRAIL_DAILY ACTIVITIES	0.82	-0.276	0.088
FRAIL_FINANCIAL	0.85	-0.047	-0.301
FRAIL_BEHAVIOUR	0.809	0.182	-0.206
FRAIL_MEMORY	0.852	0.148	-0.263
FRAIL_IADL_INSIDE	0.825	-0.248	-0.145
FRAIL_IADL_OUTSIDE	0.737	-0.305	-0.135
FRAIL_SENSES	0.763	-0.231	0.031
FRAIL_MEDICATION	0.844	-0.064	-0.268
FRAIL_ORIENTATION	0.858	0.192	-0.203
FRAIL_PLAN	0.861	0.037	-0.297
FRAIL_SOCIAL	0.83	0.026	-0.25
FRAIL_FAMILY	0.822	0.077	-0.255
LAWTON_SHOPPING	0.752	-0.285	-0.002
LAWTON_FINANCES	0.853	-0.045	-0.249
LAWTON_HOUSEKEEPING	0.743	-0.313	-0.008
LAWTON_FOOD PREPARATION	0.786	-0.278	-0.097
LAWTON_MEDICATIONS	0.844	-0.033	-0.169
LAWTON_TELEPHONE	0.833	0	-0.076
LAWTON_TRANSPORTATION	0.732	-0.278	0.084
LAWTON_LAUNDRY	0.764	-0.297	-0.075
B-ADL_CONTINENCE	0.754	-0.042	0.403
BNHBS_DESTRUCTIVE	0.441	0.572	0.239
B-ADL_EATING	0.734	-0.038	0.426
B-ADL_CLOTHING	0.783	-0.242	0.4
BNHBS_NIGHTLY BEHAVIOUR	0.595	0.546	0.103
BNHBS_UNDECENT	0.578	0.526	0.226
B-ADL_ORIENTATION SPACE	0.811	0.338	-0.039
B-ADL_ORIENTATION TIME	0.812	0.334	-0.082
BNHBS_RESTLESS	0.607	0.576	0.079
B-ADL_TOILETING	0.752	-0.153	0.49
BNHBS_EXPRESS	0.715	0.303	0.105
BNHBS_VERBAL BEHAVIOUR	0.55	0.525	0.226
B-ADL_TRANSFER	0.648	-0.307	0.499
B-ADL_WASHING	0.794	-0.231	0.343

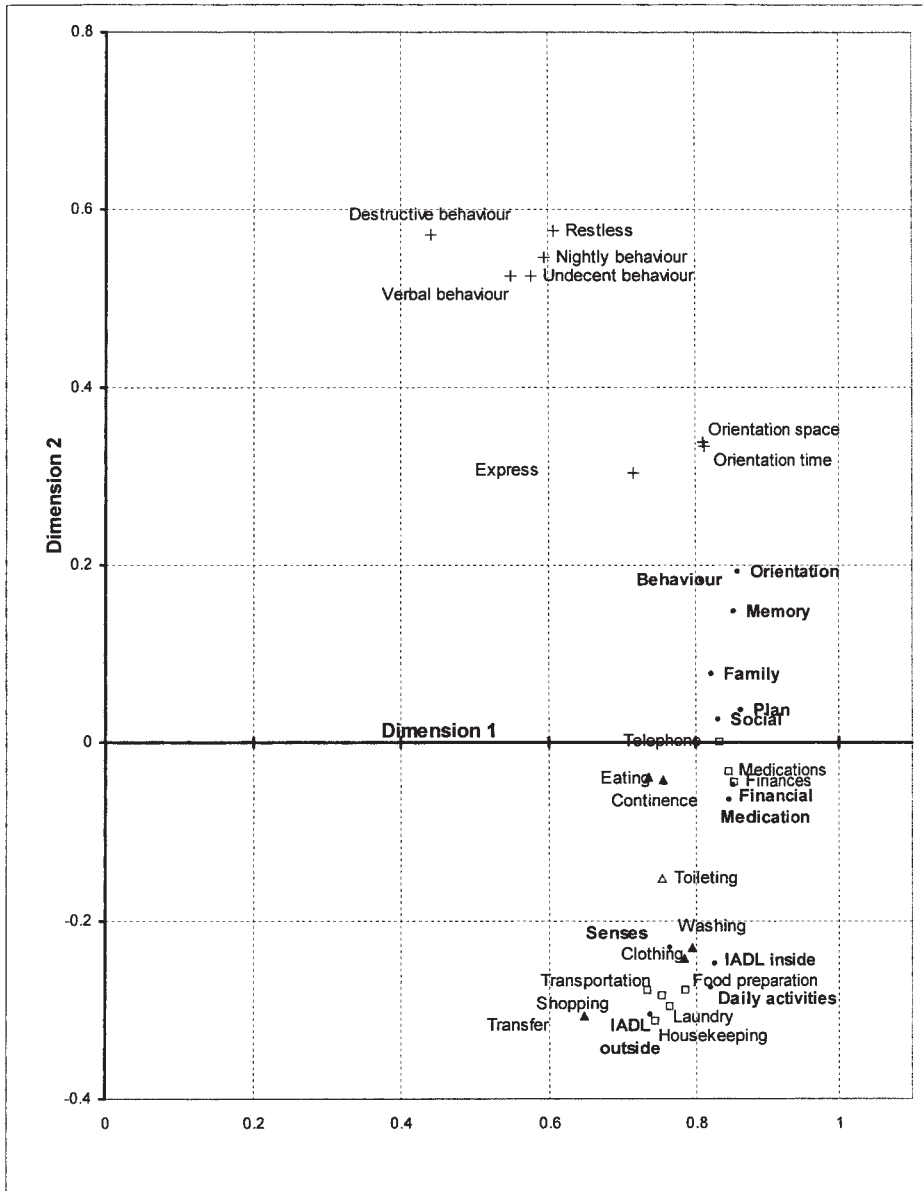


after recoding of very low frequency categories is shown in table 2. The three dimensions of the PRINCALS analysis explained 72% of all variance (sum of the Eigenvalues;  $0.58 + 0.08 + 0.06$ ). The Eigenvalue of a component (i.e. dimension) is the variation of the data 'explained' by that component. The component loadings of the scale items on the three items are presented in table 3. The component loadings express the strength of association between each of the items on the one hand and the identified component (i.e. dimension) on the other. A graphical representation of the component loadings of the variables on the first two dimensions is shown in figure 2. It can be seen that the first dimension is a measure of overall dysfunctioning since all variables exhibit high ( $> 0.4$ ) loadings on it. On the other hand, the second dimension has high positive loadings on the 'behaviour' items and negative loadings on the IADL-items. The second dimension may be interpreted as a balance between so called higher functioning and behavioral dysfunctioning. If the vectors from the crossing of the axes towards the data-points of the items are of (almost) unit length, then the angle between the two vectors reflects the correlation coefficient of the two corresponding quantified variables. In other words: variables that are plotted near to each other's are highly correlated, the correlation between variables plotted far from each other's in the graph is low. In the graph it can be seen that the FRAIL variables of the first circle (Daily activities; IADL inside and outside; Senses) are highly correlated to variables of Lawton's IADL of similar content: Laundry, Housekeeping, Transportation, Shopping, Food preparation. The FRAIL variables Medication and Financial are plotted near the 'corresponding' variables of Lawton's IADL. Since there are no variables with identical content for the FRAIL Plan, Family, Social and Memory variables, these variables are in a somewhat isolated cluster. The FRAIL Behaviour and Orientation variables are nearest to the cluster of the variables of the B-ADL Orientation and the BNHBS.

## Discussion

These studies confirm the content validity of the Frail instrument. First by confirming the results of an earlier study showing that the Frail instrument is a valuable instrument in the detection process of dementia (15;19). It has however to be stressed that a positive result of the Frail instrument alone is not enough for the diagnosis: it is a starting point in the case finding procedure that is recommended (31;32). Taking into account the diagnostic parameters for ruling out a diagnosis, the good sensitivity combined with a strong odds ratio are favorable (33). Secondly the Frail instrument correlates well with the outcome of ADL instrument like Katz and IADL assessment like the Lawton instrument. Although there is quite some dis-

Fig. 2: Graphical representation of the component loadings of the variables on the first two dimensions. The variable names are labeled



cussion about what parameters are most valuable to express frailty (34-36), activities of daily living and instrumental activities of daily living are core elements caused by frailty and disablement (6).

## Acknowledgment

This work has been funded by RIZIV/INAMI 'Studie dementie/Etude de démence UB/1240'

## References

1. Rockwood K, Hubbard R. Frailty and the geriatrician. *Age Ageing* 2004; 33(5):429-30.
2. Woodhouse KW, Campbell AJ, Schulz R. Frailty and ageing. *Age Ageing* 1997; 26:245-6.
3. Campbell A. Unstable disability and the fluctuations of frailty. *Age Ageing* 1997; 26:315-8.
4. Swinne C, Cornette P, Schoevaerds D, Latteur V, Melon C. Frailty in the medical literature. *Age Ageing* 1997; 26:411-3.
5. Slaets JP. Het belang van het 'Frailty-concept' bij case-finding in de geriatrie. *Tijdschr Gerontol Geriatr* 1998; 29:276-8.
6. Fried LP, Ferrucci L, Darer J, Williamson JD, Anderson G. Untangling the concepts of disability, frailty, and comorbidity: implications for improved targeting and care. *J Gerontol A Biol Sci Med Sci* 2004; 59(3):255-63.
7. Showstack J, Rothman A, Hassmiller S. Primary Care at Crossroads. *Ann Intern Med* 2003; 138:242-3.
8. De Lepeleire J, Heyrman J. Diagnosis and management of dementia in primary care at an early stage: the need for a new concept and an adapted procedure. *Theor Med* 1999; 20:215-28.
9. Markle-Reid M, Browne G. Conceptualizations of frailty in relation to older adults. *J Adv Nurs* 2003; 44(1):58-68.
10. Feinstein AR. An additional basic science for clinical medicine: I The constraining fundamental paradigms. *Ann Intern Med* 1983; 99:393-7.
11. Feinstein AR. An additional basic science for clinical medicine: IV The development of Clinimetrics. *Ann Intern Med* 1983; 99:843-8.
12. Feinstein AR. Clinimetric Perspectives. *J Chronic Dis* 1987; 40:635-40.
13. Heyrman J, Dessers L, De Munter H, Haepers K, Craenen J. Functional status assessment in the elderly. In: Wonca Classification Committee, editor. *Functional status in Primary Care*. New York: Springer Verlag, 1990.
14. Heyrman J, Van Hoeck K. Health status outcome instrument. Wonca, 1-30. 1992.
15. De Lepeleire J. De diagnose van dementie. Het aandeel van de Huisarts. Katholieke Universiteit Leuven, 2000.
16. Hendrie H, Brittain H, Austrom M, Farlow M, Parker J, et al. The Camdex: a standardized instrument for the diagnosis of mental disorder in the elderly: a replication with US sample. *JAGS* 1988; 36:402-8.
17. Wens L. De Camdex:cambridge mental disorders of the elderly examination. *diagnostiek-wijzer* 1997; 2:51-61.
18. Buntinx F, De Lepeleire J, Fontaine O, Ylief M. *Qualidem Eindrapport 1999-2002, versie 1.1*. Leuven/Liège: Qualidem, 2002.
19. De Lepeleire J, Heyrman J, Baro F, Buntinx F. A combination of tests for the diagnosis of dementia has a significant diagnostic value. *J Clin Epidemiol* 2005; 3:217-25.

20. Zaat J, Schellevis F. Aan je eigen haren omhoog? Over betrouwbaarheid en validiteit van instrumenten voor het meten van 'kwaliteit van leven'. *Huisarts en Wetenschap* 1995; 38:105-9.
21. König-Zahn C, Fuer J. De keuze van een vragenlijst. Methodologische en praktische overwegingen. *Huisarts en Wetenschap* 1995; 38:110-6.
22. Katz S, Ford A, Moskowitz R, Jackson B, Jaffe M. Studies of Illness in the Aged. *JAMA* 1963; 185:914-9.
23. Lawton M, Brody E. Assessment of older people: self-maintaining and instrument activities of daily living. *Gerontologist* 1969; 19:179-86.
24. Folstein M, Folstein S, Mc Hugh P. 'Mini Mental State'. A practical method for grading the cognitive state of patients for the clinician? *J Psychiatr Res* 1975; 12:189-98.
25. Roth M, Thym E, Mountjoy C, Huppert F, Hendrie H, Verma A et al. Camdex. A standardized instrument for the diagnosis of mental disorders in the elderly with special reference to the early detection of Alzheimer's disease. *Br J Psychiatry* 1986; 149:698-709.
26. Neri M, Rubichi S, DeVreese LP. Validation of the full and short forms of the CAMDEX interview for diagnosing dementia: evidence from a one-year follow-up study. *dement geriatr cogn disord* 1998; 9:339-46.
27. O'Connor D. The contribution of CAMDEX to the diagnosis of mild dementia. *Psychiatr J Univ Ottawa* 1990; 4:216-20.
28. Petersen R, Smith G, Waring S, Ivnik R, Tangolos E, Kokmen E. Mild cognitive Impairment. *Arch Neurol* 1999; 56:303-8.
29. Van den Berg G. *Princal voor beginners*. 1988. Leiden, Rijksuniversiteit Leiden.
30. Gifi A. *Nonlinear Multivariate Analysis*. Chichester: Wiley and Sons, 1990.
31. Eccles M, Clarke J, Livingstone M. North of England evidence based guidelines development project: guideline for the primary care management of dementia. *BMJ* 1998; 317:802-8.
32. Cooper B, Bickel H. Population screening and the early detection of dementing disorders in old age: a review. *Psychol Med* 1984; 14:81-95.
33. Pewsner D, Battaglia M, Minder C, Marx A, Bucher HC, Egger M. Ruling a diagnosis in or out with "SpIn" and "SnOut": a note of caution. *BMJ* 2004; 329(7459):209-13.
34. Rockwood K, Fox RA, Stolee P, Robertson D, Beattie BL. Frailty in elderly people: an evolving concept. *CMAJ* 1994; 150(4):489-95.
35. Syddall H, Cooper C, Martin F, Briggs R, Aihie SA. Is grip strength a useful single marker of frailty? *Age Ageing* 2003; 32(6):650-6.
36. Hogan DB, MacKnight C, Bergman H. Models, definitions, and criteria of frailty. *Aging Clin Exp Res* 2003; 15(3 Suppl):1-29.