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Associations between multidimensional frailty and quality of life among Dutch older people

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ABSTRACT

Purpose: To examine the associations between components of physical, psychological and social frailty with quality of life among older people.

Methods: This cross-sectional study was carried out in a sample of Dutch citizens. A total of 671 people aged 70 years or older completed a web-based questionnaire ('the Senioren Barometer'). This questionnaire contained the Tilburg Frailty Indicator (TFI) for measuring physical, psychological and social frailty, and the WHOQOL-OLD for measuring six quality of life facets (sensory abilities, autonomy, past, present and future activities, social participation, death and dying, intimacy) and quality of life total.

Results: Nine of fifteen individual frailty components had an effect on at least one facet of quality of life and quality of life total, after controlling for socio-demographic factors, multimorbidity and the other frailty components. Of these nine components five, two and two refer to physical, psychological and social frailty, respectively. Feeling down was the only frailty component associated with all quality of life facets and quality of life total. Both physical inactivity and lack of social relations were associated with four quality of life facets and quality of life total.

Conclusion: This study showed that quality of life in older people is associated with physical, psychological and social frailty components, emphasizing the importance of a multidimensional assessment of frailty. Health care and welfare professionals should in particular pay attention to feeling down, physical inactivity and lack of social relations among older people, because their relation with quality of life seems to be the strongest.

1. Introduction

Population ageing is occurring throughout the world. Currently, Europe has the greatest percentage of its population aged 60 or over (24 per cent) and that proportion is projected to reach 34 per cent in 2050 (United Nations Department of Economic and Social Affairs, 2015). In 2015, 24.5 per cent of the people in the Netherlands are 60 years and older, and 4.4 per cent of the people in this country are 80 years and older (United Nations Department of Economic and Social Affairs, 2015). In 2050, both percentages will grow to 33.2 and 11.8, respectively (United Nations Department of Economic and Social Affairs, 2015). These demographic changes makes assessing quality of life in older people more and more important; poor quality of life is a predictor of institutionalization and death within a year (Bilotta et al., 2011). Quality of life has been defined by the World Health Organization Quality of Life Group (1995, p. 1405) as 'an individual's

perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns' (The WHOQOL Group, 1995).

Previous studies have shown that lower quality of life in older people is associated with physical frailty (Chang et al., 2012; Lin et al., 2011; Masel, Ostir, & Ottenbacher, 2010; Moreno-Aguilar et al., 2013), examined using the phenotype of frailty by Fried et al. based on physical activity, unintentional weight loss, walking speed, grip strength, and exhaustion (Fried et al., 2001). Other studies demonstrated associations between poor quality of life and multidimensional frailty (Gobbens & van Assen, 2014; Gobbens, Luijkx, & van Assen, 2013), which has been defined as: 'A dynamic state affecting an individual who experiences losses in one or more domains of human functioning (physical, psychological, social), caused by the influence of a range of variables and which increases the risk of adverse outcomes' (Gobbens, Luijkx, Wijnen-Sponselee, & Schols, 2010a, 2010b). Adding

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psychological and social frailty components to a model containing physical frailty components, socio-demographic factors and multimorbidity improved the prediction of quality of life in people aged 65 years and older (Gobbens et al., 2013). Moreover, a longitudinal study demonstrated that four physical frailty components (physical unhealthy, difficulty in maintaining balance, difficulty in walking, physical tiredness), one psychological frailty component (feeling down) and one social component (lack of social support) predicted quality of life, after controlling for background characteristics (socio-demographic factors, diseases) (Gobbens & van Assen, 2014).

In the aforementioned studies quality of life was assessed using the WHOQOL-BREF, which is a measurement instrument with four facets of quality of life (physical health, psychological, social relations, environmental) that is not particularly developed for assessing quality of life in older people (The WHOQOL Group, 1998). That is, fundamental aspects in the composition of quality of life in older adults are not included in the WHOQOL-BREF, such as social contacts and thoughts regarding meaningful past and future (Bowling et al., 2003). That is why we have decided to adopt the World Health Organization Quality of Life Instrument-Older Adults Module (WHOQOL-OLD) for measuring quality of life in the present study. The WHOQOL-OLD is a multidimensional measure of quality of life in older persons that has been developed by the WHOQOL Group following the WHOQOL Group methodology used to develop both the WHOQOL-100 and the WHOQOL-BREF (Power, Quinn, & Schmidt, 2005). The WHOQOL-OLD is characterized by six facets that are important for older people: (i) sensory abilities, (ii) autonomy, (iii) past, present, and future activities, (iv) social participation, (v) death and dying, and (vi) intimacy.

In the present study we examine the associations of quality of life with both frailty and socio-demographic characteristics. Some studies have already examined the associations between socio-demographic characteristics and quality of life using the WHOQOL-OLD (Bilgili & Arpacı, 2014; Bowling, 2009; Conrad, Matschinger, Riedel-Heller, von Gottberg, & Kilian, 2014; Lucas-Carrasco, Laidlaw, & Power, 2011; Power et al., 2005). A study by Bowling based on three British surveys of community-dwelling older people (≥ 65 years) showed that older age was inversely associated with the WHOQOL-OLD total score (Bowling, 2009). Power et al. (2005) observed lower quality of life scores on all facets of the WHOQOL-OLD in participants aged 80 years or older compared with participants in the age group 57–79 years, except for the facet death and dying. Conrad et al. (2014) found a negative association between age and sensory abilities in German older people (≥ 60 years) and a Turkish study among community-dwelling older adults in the same age group showed a positive association between age and sensory abilities, and negative associations with social participation and intimacy (Bilgili & Arpacı, 2014). However, a study by Lucas-Carrasco et al. (2011) demonstrated no differences in WHOQOL-OLD total score in age groups (60–79, 80+). Likewise, no consensus exists on effects of sex, marital status and education level on quality of life and its facets. The study by Conrad et al. (2014) showed that being a woman was negatively associated with autonomy, and Power et al. (2005) concluded that sex effects were comparative small, and occurred mainly for death and dying with higher scores for men; on the other hand Lucas-Carrasco et al. (2011) found no differences in WHOQOL-OLD total score with regard to sex, and Bowling (2009) found no associations between the total score and sex.

According to Conrad et al. (2014), being married is not associated with the six quality of life facets of the WHOQOL-OLD. However, the studies by Bowling (2009) and Bilgili and Arpacı (2014) showed that married people experienced a better quality of life. Higher education was associated with higher scores on past, present and future activities (Conrad et al., 2014) and the total score on the WHOQOL-OLD (Lucas-Carrasco et al., 2011). Another study showed associations between higher education of older people and quality of life facets autonomy, past, present and future activities, social participation, death and dying, and quality of life total, and lower scores for sensory abilities

(Bilgili & Arpacı, 2014). Finally, Bilgili and Arpacı (2014) observed higher quality of life on five domains for older people with higher income, with the exception of sensory abilities.

Currently, no studies have been conducted on the associations between multidimensional frailty and quality of life measured with the WHOQOL-OLD. As aging is connected with having more life experiences, increased time to spend together with (grand)children, and aging increases the change of experiencing losses such as losing a partner and suffering from illness, we consider it vital to also examine the associations of frailty with these dimensions of quality of life that are particularly important for older persons. Because WHOQOL-OLD's facets are specifically developed for older people and these facets are very different from those of other instruments such as the WHOQOL-BREF, using the WHOQOL-OLD will provide both new and more relevant information on the associations between frailty and quality of life of older people. The present cross-sectional study examines the associations of the three domains of multidimensional frailty (physical, psychological, social) and their components with quality of life, incorporating sensory abilities, autonomy, past, present, and future activities, social participation, death and dying, intimacy, in a sample of people aged 70 years and older. Insight into these associations could provide targets for health care and welfare professionals with the aim to enhance quality of life in this population.

2. Methods

2.1. Study population and data collection

As in previous studies we used the data collected by “Senioren Barometer”, a Web-based questionnaire to assess the opinion of a panel of Dutch older people aged 50 years and older about different aspects of life (Gobbens et al., 2013; Gobbens, van Assen, & Schalk, 2014). Because frailty is associated with greater age (Collard, Boter, Schoevers, & Oude Voshaar, 2012; Fried et al., 2001) and the WHOQOL-OLD is developed for older persons, we selected people ≥ 70 years. In the period December 2009 and January 2010, 671 people in that age group completed the “Senioren Barometer”, containing questions regarding quality of life, frailty, socio-demographic factors, and multimorbidity.

Medical ethics approval was not necessary as particular treatments or interventions were not offered or withheld from respondents as a consequence of participating in the study, the main criterion in medical ethical procedures in the Netherlands (Central Committee on Research Inv. Human Subjects, 2010). Informed consent, in terms of information-giving and maintaining confidentiality, was respected.

2.2. Measures

2.2.1. Frailty

Frailty was assessed using part B of the Tilburg Frailty Indicator (TFI), a self-report questionnaire (Gobbens, van Assen, Luijckx, Wijnen-Sponselee, & Schols, 2010). The questionnaire contains fifteen components, referring to physical frailty (eight components), psychological frailty (four components), and social frailty (three components). The scores range from 0 to 15, 0 to 8, 0 to 4, and 0 to 3 for total, physical, psychological and social frailty, respectively, with higher scores referring to more frailty. For a detailed description of the content and scoring system of the TFI we refer to previous studies (Gobbens, van Assen et al., 2010). The TFI has shown adequate psychometric properties (Gobbens, van Assen et al., 2010; Gobbens, van Assen, Luijckx, & Schols, 2012).

2.2.2. Quality of life

The WHOQOL-OLD comprises 24 items divided into six facets of four items each. These facets are: sensory abilities, autonomy, past, present, and future activities, social participation, death and dying, and

intimacy. Responses were rated on a 5-point Likert scale (1–5), varying in their wording, with higher scores indicating better quality of life. Sum scores were created for each of the six facets and for the WHOQOL-OLD total, which is the sum of these six facets. Several studies have reported the reliability and validity of the WHOQOL-OLD (Conrad et al., 2014; Fleck, Chachamovich, & Trentini, 2006; Halvorsrud, Kalfoss, & Diseth, 2008); recently the Dutch version of the WHOQOL-OLD demonstrated good psychometric properties (Gobbens & van Assen, 2016). In the present study, the reliability, expressed by the Cronbach's alpha for the facets sensory abilities, autonomy, past, present, and future activities, social participation, death and dying, intimacy and quality of life total was 0.89, 0.91, 0.65, 0.79, 0.80, 0.64 and 0.87, respectively.

2.2.3. Background characteristics: socio-demographic and multimorbidity

Socio-demographic factors considered were: age, sex, marital status, highest education attained, and net household income. Multimorbidity was determined with one question: 'Do you have two or more diseases and/or chronic disorders?' (yes/no).

2.3. Analysis strategies

After determining the characteristics of the participants using descriptive statistics, variables were coded for analysis similar to a previous study (Gobbens et al., 2013). Then we reported correlations between the three frailty domains and the six quality of life facets and the significance of these correlations. Bivariate associations between each background variable (socio-demographic, multimorbidity) and frailty component of the TFI on the one hand and the six facets of quality of life and quality of life total on the other hand were tested using bivariate regression analyses. The sequential linear regression analyses consisted of two blocks. The effect of the background characteristics was estimated in the first block and the second block contained the fifteen frailty components of the TFI. The second block enabled testing the effect of an individual frailty component on quality of life facets and quality of life total, after controlling for background characteristics as well as the other frailty components.

For statistical analysis, IBM SPSS Statistics 22.0 (IBM, Armonk, NY, USA) was used.

3. Results

3.1. Participant characteristics

The sample comprised 466 men (69.4%), aged 70–95 years (mean 76.6 ± 4.7 years), and 69.8% were married or cohabiting; multimorbidity was present at 39.6% of the participants. Detailed information regarding the participant characteristics is presented in Table 1. Table 1 also contains information about frailty and quality of life of the participants. Applying the cut-off point five of the TFI (Gobbens, van Assen et al., 2010), the prevalence of frailty in the sample is 31.1%. Frailty components with the highest scores were lack of social relations (53.1%) and feeling down (42.8%).

3.2. Correlations between frailty domains and quality of life facets

Table 2 shows the correlations between frailty domains physical, psychological and social and the quality of life facets sensory abilities, autonomy, past, present, and future activities, social participation, death and dying, and intimacy. All correlations were significant, with the exception of the correlation between social frailty and quality of life autonomy. Physical frailty had the strongest correlation with quality of life sensory abilities (-0.510). Psychological frailty had the strongest correlation with quality of life past, present and future activities (-0.450), and social frailty with quality of life intimacy (-0.549). Of the six quality of life facets the correlation between past, present and

Table 1
Participants characteristics ($n = 671$).

Characteristic	n (%)
Age, mean \pm SD, range	76.6 \pm 4.7, 70–95
Sex, % of men	466 (69.4)
Marital status	
Married or cohabiting	468 (69.8)
Single	60 (8.9)
Divorced	23 (3.5)
Living apart together	7 (1.0)
Widowed	113 (16.8)
Education	
None	44 (6.6)
Primary	67 (10.0)
Secondary	285 (42.5)
Polytechnics and higher vocational training	217 (32.3)
University	58 (8.6)
Monthly income ^a	
€999 or less	7 (1.2)
€1000–€1499	83 (13.8)
€1500–€1999	109 (18.2)
€2000–€2499	153 (25.5)
€2500–€2999	89 (14.8)
€3000–€3499	72 (12.0)
€3500–€3999	42 (7.0)
€4000–€4499	25 (4.2)
€4500 or more	20 (3.3)
Multimorbidity, % yes	266 (39.6)
Frailty assessed with the TFI	
Frailty total, mean \pm SD	3.4 \pm 2.6
Physical frailty, mean \pm SD	1.6 \pm 1.7
Q11 Physical inactivity	128 (19.1)
Q12 Unexplained weight loss	24 (3.6)
Q13 Difficulty in walking	211 (31.4)
Q14 Difficulty in maintaining balance	122 (18.2)
Q15 Poor hearing	201 (30.0)
Q16 Poor vision	67 (10.0)
Q17 Lack of strength in the hands	140 (20.9)
Q18 Physical tiredness	206 (30.7)
Psychological frailty, mean \pm SD	0.81 \pm 0.95
Q19 Problems with memory	28 (4.2)
Q20 Feeling down	287 (42.8)
Q21 Feeling nervous or anxious	164 (24.4)
Q22 Unable to cope with problems	63 (9.4)
Social frailty, mean \pm SD	0.95 \pm 0.93
Q23 Living alone	207 (30.8)
Q24 Lack of social relations	356 (53.1)
Q25 Lack of social support	77 (11.5)
Quality of life assessed with the WHOQOL-OLD	
Quality of life total, mean \pm SD	90.8 \pm 9.9
Sensory abilities, mean \pm SD	16.0 \pm 3.0
Autonomy, mean \pm SD	14.8 \pm 2.1
Past, present and future activities, mean \pm SD	15.2 \pm 2.0
Social participation, mean \pm SD	15.3 \pm 2.5
Death and dying, mean \pm SD	15.1 \pm 3.0
Intimacy, mean \pm SD	14.3 \pm 3.1

^a 71 Missing values (10.6%).

future activities and social participation was the strongest (0.641).

3.3. Bivariate and sequential linear regression analyses

Table 3 shows the results of the bivariate regression analyses on quality of life facets and quality of life total, with p -values significant at 0.05 printed in bold. The background characteristics were associated with three (sex, marital status) to seven (multimorbidity) of the quality of life variables. All characteristics were associated with quality of life autonomy and intimacy. The individual frailty components were associated with at least three quality of life variables; two-thirds (ten) of the components were associated with all quality of life variables. This concerns both physical (five out of eight), psychological (three out of

Table 2
Correlations between frailty domains and quality of life facets.

	Frailty psychological	Frailty social	Quality of life sensory abilities	Quality of life autonomy	Quality of life past, present and future activities	Quality of life social participation	Quality of life death and dying	Quality of life intimacy
Frailty physical	0.289***	0.246***	−0.510***	−0.372***	−0.332***	−0.352***	−0.186***	−0.203***
Frailty psychological		0.261***	−0.239***	−0.355***	−0.450***	−0.349***	−0.305***	−0.274***
Frailty social			−0.105**	−0.075	−0.257***	−0.238***	−0.150***	−0.549***
Quality of life sensory abilities				0.301***	0.254***	0.222***	0.107**	0.124**
Quality of life autonomy					0.594***	0.540***	0.223***	0.211***
Quality of life past, present and future activities						0.641***	0.268***	0.397***
Quality of life social participation							0.186***	0.325***
Quality of life death and dying								0.172***

** $p < 0.01$.
*** $p < 0.001$

four) and social frailty components (two out of three).

Table 3 also shows the results of the sequential linear regression analyses. The lines ' R^2 (total)' indicate how much of the variance was explained by all the predictors together (last row), or in each block (last row of each block), and whether (the increase in) explained variance was statistically significant. The last row shows that all the predictors together explained 14% (death and dying) to 53% (sensory abilities). The frailty components explained a significant part of all six quality of life facets after controlling for background characteristics, with increases in explained variance varying from 9.8% (death and dying) to 43.4% (sensory abilities). Effect sizes were small to medium (up to 15%) for two facets intimacy, death and dying, medium to large (15–35%) for total quality of life and three facets autonomy, social participation, and past, present, and future, and large (> 35%) for sensory abilities.

In addition, Table 3 presents the effect of each of the background characteristics and individual frailty components on quality of life facets and quality of life total. Of the background characteristics sex (being a woman) was associated with the most quality of life facets; scores on sensory abilities, autonomy, past, present and future activities, social participation, and quality of life total were higher for women. Lower age was associated with higher quality of life autonomy and social participation. However, greater age was associated with higher quality of life death and dying. Being married or cohabiting was positively associated with intimacy, and higher income was associated with higher scores on quality of life autonomy, past, present and future activities, intimacy and quality of life total. Finally, multimorbidity was only associated with a lower score on sensory abilities.

The sequential linear regression analyses demonstrated that the psychological frailty component feeling down was the only frailty component that had an effect on all six quality of life facets and quality of life total, after controlling for all other effects. Both the physical frailty component physical inactivity and the social frailty component lack of social relations had an effect on five quality of life facets. Six frailty components (unexplained weight loss, difficulty in walking, lack of strength in the hands, problems with memory, unable to cope with problems, living alone) had no effect on any of the quality of life variables, after controlling for all other effects. Nine frailty components had an effect on quality of life total. Only feeling down and feeling nervous or anxious were associated with lower scores on death and dying.

4. Discussion

The aim of the present cross-sectional study was to determine the

associations between multidimensional frailty and quality of life, using a sample of 671 people aged 70 years and older in the Netherlands. We used two validated assessment tools: the TFI for measuring physical, psychological, and social frailty and its fifteen components and the WHOQOL-OLD for measuring quality in life, distinguishing six facets sensory abilities, autonomy, past, present, and future activities, social participation, death and dying, and intimacy.

The bivariate regression analyses showed that multimorbidity and ten components of frailty were associated with all six quality of life facets and quality of life total. Most of the explained variance of five quality of life facets and quality of life total was accounted for frailty, with the exception of intimacy; an explanation for this finding is the importance of marital status (being married) for intimacy. That frailty explained most of the variance of sensory abilities is not surprising, because two frailty components (poor hearing, poor vision) are also part of sensory functioning. However, regardless of whether poor hearing and poor vision are part of the assessment of frailty, understanding their impact is important to help older people to preserve and maintain a good quality of life (Rooth, 2017). Nine individual frailty components had an effect on at least one facet of quality of life and quality of life total, after controlling for all the other variables in the model. Of these nine components five, two, and two refer to physical, psychological and social frailty, respectively; this finding underlines the relevance of a multidimensional definition and measurement of frailty. Most of our findings are as expected. We will discuss some remarkable findings below.

Both quality of life facets autonomy and past, present and future activities were explained by frailty components physical activity, physical tiredness, feeling down or anxious and lack of social relations; this can partly be explained by the strong association between these two quality of life facets. Our finding that physical inactivity was associated with lower scores on multiple quality of life facets (sensory abilities, autonomy, past, present and future activities, social participation) is supported by a recent systematic review (Vagetti et al., 2014). The associations found in this and our study suggest that physical activity may promote physical independence as well as essential mental aspects of quality of life. A better understanding of the relationship between physical activity and quality of life is important to propose recommendations addressing lifestyle changes in older persons. Recently, clinical practice guidelines for frailty were developed emphasizing that frail older people should be referred to a progressive, individualized physical activity program that contains a resistance training component (Dent et al., 2017). According to these guidelines older people are more likely to adhere to a physical activity program if the program is individually tailored (Bauman, Merom, Bull, Buchner, & Fiatarone Singh,

Table 3
Effect of background characteristics and frailty components on WHOQOL-OLD facets: regression analysis.

	Sensory abilities						Autonomy					
	Bivariate			Multiple			Bivariate			Multiple		
	B	SE	p	B	SE	p	B	SE	p	B	SE	p
Background characteristics												
Sex (women)	0.280	0.252	0.267	0.763	0.218	0.001	0.445	0.175	0.011	0.726	0.179	< 0.001
Age	-0.111	0.024	< 0.001	0.002	0.020	0.918	-0.082	0.017	< 0.001	-0.059	0.016	< 0.001
Marital status (married)	0.078	0.253	0.757	-1.222	0.687	0.076	-0.424	0.176	0.016	-0.535	0.564	0.344
Education	0.214	0.118	0.070	0.063	0.100	0.527	0.268	0.082	0.001	-0.021	0.082	0.797
Income	0.188	0.066	0.004	0.073	0.058	0.207	0.234	0.045	< 0.001	0.259	0.048	< 0.001
Multimorbidity	-1.401	0.231	< 0.001	-0.582	0.201	0.004	-0.927	0.162	< 0.001	0.024	0.165	0.886
ΔR^2				0.096		< 0.001				0.168		< 0.001
Frailty components												
Physical inactivity	-1.687	0.288	< 0.001	-0.572	0.281	0.042	-1.634	0.197	< 0.001	-0.656	0.231	0.005
Unexplained weight loss	-1.343	0.622	0.031	0.208	0.480	0.665	-1.041	0.435	0.017	0.055	0.395	0.890
Difficulty in walking	-1.635	0.242	< 0.001	-0.240	0.234	0.307	-1.146	0.169	< 0.001	-0.261	0.193	0.175
Difficulty maintaining balance	-1.878	0.292	< 0.001	-0.556	0.260	0.033	-1.254	0.205	< 0.001	-0.429	0.213	0.045
Poor hearing	-4.048	0.199	< 0.001	-3.461	0.201	< 0.001	-0.606	0.176	0.001	-0.052	0.165	0.752
Poor vision	-3.648	0.360	< 0.001	-2.209	0.298	< 0.001	-0.599	0.270	0.027	-0.083	0.245	0.735
Lack of strength in the hands	-1.356	0.281	< 0.001	-0.445	0.240	0.064	-0.887	0.197	< 0.001	-0.068	0.197	0.729
Physical tiredness	-1.557	0.244	< 0.001	0.185	0.226	0.414	-1.475	0.166	< 0.001	-0.735	0.185	< 0.001
Problems with memory	-0.978	0.579	0.091	-0.270	0.445	0.544	-1.060	0.404	0.009	-0.490	0.366	0.180
Feeling down	-1.168	0.230	< 0.001	-0.534	0.203	0.009	-1.281	0.156	< 0.001	-0.685	0.166	< 0.001
Feeling nervous or anxious	-1.350	0.265	< 0.001	-0.152	0.234	0.516	-1.367	0.181	< 0.001	-0.503	0.192	0.009
Unable to cope with problems	-1.258	0.395	0.002	-0.006	0.325	0.985	-1.170	0.274	< 0.001	-0.028	0.267	0.917
Living alone	-0.197	0.251	0.432	-1.026	0.678	0.130	0.382	0.175	0.030	0.724	0.557	0.194
Lack of social relations	-0.562	0.231	0.015	-0.136	0.192	0.479	-0.581	0.161	< 0.001	-0.345	0.158	0.029
Lack of social support	-1.077	0.352	0.003	-0.051	0.295	0.863	-0.814	0.253	0.001	-0.294	0.243	0.227
ΔR^2				0.434		< 0.001				0.174		< 0.001
R^2 total				0.530		< 0.001				0.342		< 0.001
Past, present and future activities												
Social participation												
	Past, present and future activities						Social participation					
	Bivariate			Multiple			Bivariate			Multiple		
	B	SE	p	B	SE	p	B	SE	p	B	SE	p
Background characteristics												
Sex (women)	-0.132	0.166	0.428	0.427	0.166	0.010	0.249	0.206	0.228	0.963	0.213	< 0.001
Age	-0.025	0.016	0.132	0.013	0.015	0.383	-0.083	0.020	< 0.001	-0.046	0.019	0.017
Marital status (married)	0.186	0.167	0.264	-0.078	0.524	0.882	0.226	0.207	0.275	-0.281	0.672	0.676
Education	0.330	0.077	< 0.001	0.065	0.076	0.396	0.315	0.096	0.001	0.138	0.097	0.157
Income	0.253	0.041	0.001	0.174	0.044	< 0.001	0.189	0.053	< 0.001	0.067	0.057	0.235
Multimorbidity	-0.769	0.154	< 0.001	0.068	0.153	0.657	-1.005	0.190	< 0.001	0.019	0.197	0.922
ΔR^2				0.091		< 0.001				0.087		< 0.001
Frailty components												
Physical inactivity	-1.465	0.187	< 0.001	-0.508	0.214	0.018	-2.149	0.227	< 0.001	-0.943	0.275	0.001
Unexplained weight loss	-1.167	0.410	0.005	-0.007	0.366	0.985	-1.979	0.506	< 0.001	-0.522	0.470	0.267
Difficulty in walking	-0.954	0.161	< 0.001	-0.305	0.179	0.088	-1.380	0.198	< 0.001	-0.149	0.229	0.517
Difficulty maintaining balance	-0.846	0.196	< 0.001	-0.170	0.198	0.391	-1.489	0.240	< 0.001	-0.810	0.254	0.001
Poor hearing	-0.461	0.166	0.006	-0.172	0.154	0.262	-0.222	0.207	0.284	0.334	0.197	0.090
Poor vision	-0.646	0.254	0.011	-0.088	0.227	0.700	-0.394	0.317	0.214	0.117	0.291	0.689
Lack of strength in the hands	-0.715	0.187	< 0.001	0.034	0.183	0.851	-0.952	0.231	< 0.001	0.015	0.235	0.950
Physical tiredness	-1.303	0.158	< 0.001	-0.374	0.172	0.030	-1.646	0.196	< 0.001	-0.703	0.221	0.002
Problems with memory	-0.926	0.381	0.015	-0.436	0.339	0.200	-0.190	0.475	0.690	0.385	0.435	0.377
Feeling down	-1.643	0.141	< 0.001	-0.904	0.154	< 0.001	-1.743	0.180	< 0.001	-1.087	0.198	< 0.001
Feeling nervous or anxious	-1.559	0.168	< 0.001	-0.585	0.178	0.001	-1.503	0.213	< 0.001	-0.418	0.228	0.067
Unable to cope with problems	-1.404	0.257	< 0.001	-0.268	0.248	0.281	-1.217	0.323	< 0.001	-0.024	0.318	0.940
Living alone	-0.204	0.166	0.219	0.542	0.517	0.294	-0.267	0.206	0.194	0.197	0.662	0.767
Lack of social relations	-1.055	0.148	< 0.001	-0.589	0.146	< 0.001	-1.195	0.185	< 0.001	-0.553	0.188	0.003
Lack of social support	-1.629	0.232	< 0.001	-0.679	0.225	0.003	-1.849	0.290	< 0.001	-0.893	0.289	0.002
ΔR^2				0.232		< 0.001				0.221		< 0.001
R^2 total				0.323		< 0.001				0.308		< 0.001
Death and dying												
Intimacy												
	Death and dying						Intimacy					
	Bivariate			Multiple			Bivariate			Multiple		
	B	SE	p	B	SE	p	B	SE	p	B	SE	p
Background characteristics												
Sex (women)	-0.886	0.251	< 0.001	-0.463	0.295	0.117	-1.491	0.252	< 0.001	-0.006	0.265	0.981

(continued on next page)

Table 3 (continued)

	Death and dying						Intimacy					
	Bivariate			Multiple			Bivariate			Multiple		
	B	SE	p	B	SE	p	B	SE	p	B	SE	p
Age	0.014	0.025	0.564	0.062	0.027	0.020	-0.061	0.025	0.016	0.000	0.024	0.985
Marital status (married)	0.494	0.253	0.051	-0.979	0.928	0.292	3.155	0.229	< 0.001	1.818	0.833	0.029
Education	-0.020	0.119	0.867	-0.043	0.135	0.751	0.315	0.121	0.009	-0.020	0.121	0.869
Income	0.042	0.066	0.526	-0.106	0.078	0.174	0.508	0.066	< 0.001	0.169	0.070	0.016
Multimorbidity	-0.767	0.236	0.001	-0.407	0.272	0.135	-0.796	0.242	0.001	-0.209	0.244	0.391
ΔR^2				0.042		< 0.001				0.257		< 0.001
Frailty components												
Physical inactivity	-0.962	0.294	0.001	-0.048	0.379	0.900	-1.347	0.299	< 0.001	0.162	0.340	0.633
Unexplained weight loss	-0.735	0.627	0.242	0.284	0.649	0.662	-2.008	0.637	0.002	-1.132	0.582	0.052
Difficulty in walking	-0.696	0.250	0.005	-0.359	0.317	0.257	-0.788	0.255	0.002	0.018	0.284	0.950
Difficulty maintaining balance	-0.653	0.301	0.030	-0.007	0.351	0.984	-0.680	0.308	0.027	0.227	0.315	0.470
Poor hearing	-0.318	0.254	0.211	0.005	0.272	0.986	-0.541	0.259	0.037	-0.355	0.244	0.146
Poor vision	-0.955	0.387	0.014	-0.562	0.402	0.163	-0.034	0.398	0.931	0.508	0.361	0.160
Lack of strength in the hands	-0.927	0.285	0.001	-0.065	0.324	0.841	-1.036	0.291	< 0.001	-0.023	0.291	0.937
Physical tiredness	-1.171	0.249	< 0.001	-0.251	0.305	0.410	-1.195	0.254	< 0.001	-0.195	0.274	0.475
Problems with memory	-0.273	0.583	0.639	0.488	0.601	0.417	-0.654	0.595	0.272	-0.537	0.540	0.320
Feeling down	-1.418	0.229	< 0.001	-0.598	0.274	0.029	-1.981	0.228	< 0.001	-1.013	0.246	< 0.001
Feeling nervous or anxious	-2.047	0.259	< 0.001	-1.426	0.315	< 0.001	-1.188	0.274	< 0.001	0.112	0.283	0.693
Unable to cope with problems	-1.599	0.395	< 0.001	-0.613	0.439	0.163	-0.841	0.407	0.039	-0.104	0.394	0.792
Living alone	-0.519	0.252	0.040	-1.001	0.915	0.274	-3.129	0.228	< 0.001	-0.429	0.821	0.602
Lack of social relations	-0.800	0.232	0.001	-0.279	0.259	0.282	-2.214	0.223	< 0.001	-0.824	0.233	< 0.001
Lack of social support	-1.063	0.363	0.004	-0.325	0.399	0.415	-3.444	0.349	< 0.001	-2.126	0.358	< 0.001
ΔR^2				0.098		< 0.001				0.112		< 0.001
R^2 total				0.140		< 0.001				0.369		< 0.001
WHOQOL-OLD												
	Bivariate			Multiple								
	B	SE	p	B	SE	p						
Background characteristics												
Sex (women)	-1.536	0.827	0.064	2.410	0.742	0.001						
Age	-0.347	0.080	< 0.001	-0.029	0.067	0.668						
Marital status (married)	3.716	0.819	< 0.001	-1.276	2.336	0.585						
Education	1.422	0.386	< 0.001	0.182	0.339	0.592						
Income	1.415	0.205	< 0.001	0.636	0.197	0.001						
Multimorbidity	-5.665	0.749	< 0.001	-1.087	0.685	0.113						
ΔR^2				0.161		< 0.001						
Frailty components												
Physical inactivity	-9.243	0.904	< 0.001	-2.565	0.955	0.007						
Unexplained weight loss	-8.273	2.031	< 0.001	-1.114	1.633	0.496						
Difficulty in walking	-6.597	0.782	< 0.001	-1.296	0.979	0.105						
Difficulty maintaining balance	-6.801	0.954	< 0.001	-1.745	0.883	0.049						
Poor hearing	-6.198	0.798	< 0.001	-3.702	0.685	< 0.001						
Poor vision	-6.276	1.250	< 0.001	-2.317	1.012	0.022						
Lack of strength in the hands	-5.873	0.912	< 0.001	-0.522	0.817	0.499						
Physical tiredness	-8.346	0.762	< 0.001	-2.074	0.767	0.007						
Problems with memory	-4.082	1.903	0.032	-0.861	1.513	0.570						
Feeling down	-9.234	0.684	< 0.001	-4.821	0.689	< 0.001						
Feeling nervous or anxious	-9.015	0.817	< 0.001	-2.972	0.794	< 0.001						
Unable to cope with problems	-7.488	1.277	< 0.001	-1.043	1.106	0.346						
Living alone	-3.934	0.813	< 0.001	-0.993	2.304	0.667						
Lack of social relations	-6.407	0.724	< 0.001	-2.726	0.653	< 0.001						
Lack of social support	-9.876	1.136	< 0.001	-4.367	1.004	< 0.001						
ΔR^2				0.318		< 0.001						
R^2 total				0.479		< 0.001						

2016) and contains self-efficacy training (Liu & Latham, 2011).

Physical, as well as psychological and social frailty components, were negatively associated with quality of life facet social participation. Qualitative studies also identified having poor social relationships as one of the main factors that affected quality of life in older people negatively (Gabriel & Bowling, 2004; Puts et al., 2007). In particular, Puts et al. (2007) showed that for frail older persons social contacts is the most important factor for quality of life, while non-frail older persons report health as the most important. Moreover, in older Americans

loneliness was a significant independent predictor of functional decline and increased mortality (Luo, Hawkey, Waite, & Cacioppo, 2012; Perissinotto, Stijacic Cenzer, & Covinsky, 2012). So, interventions focusing on predictors of quality of life facet social participation (e.g. physical activity, maintaining balance) are of interest. Forming social relationships amongst peers and being in touch with others was a clear motive of older persons to join an exercise program; this should be taken into account when designing interventions promoting physical exercise (Mehra et al., 2016).

Higher scores on quality of life facet death and dying was associated with higher age; a finding also supported by Power et al. (2005). That is remarkable because death and dying are more relevant as you age. Apparently people at old age are not afraid to die. To die at the preferred site is considered one of the key principles of a good death (Smith, 2000). The views of older people regarding death and dying are of the utmost importance for healthcare and welfare professionals to know, since they may form the basis for how to approach people at the end of life and release them from death anxiety. Findings from a literature review support the view that older persons do want to speak about death and dying (Hallberg, 2004). To support people towards the end of their lives is being increasingly recognized as an important aspect of health and social care (Sharp, Moran, Kuhn, & Barclay, 2013). Two frailty components were negatively associated with quality of life facet death and dying, feeling down and feeling nervous or anxious. In studies by Breitbart et al. (2000) and Chochinov et al. (1995) among terminally ill people depression was one of the main variables that explained the desire of death.

Intimacy, if not sexuality, is a continuing human need for most people (Rheume & Mitty, 2008). A study demonstrated that around 48% of the subjects above the age of 50 years did not perceive any change in the areas of love and intimacy in their relationship over the years (Kalra, Subramanyam, & Pinto, 2011). In our study intimacy was influenced by feeling down, lack of social relations as well as lack of social support, and none of the physical frailty components. It is suggested that intimacy consists of five distinct components: commitment, mutuality, emotional intimacy, cognitive intimacy, and physical intimacy (Moss, Schwebel, & Andrew, 1993). All these components are related to having social relationships, between partners, among friends, and between parents and their children. Hence intimacy's association with social frailty indicators should not come as a surprise.

Several other instruments have been developed for assessing quality of life in older persons, e.g. the WHOQOL-AGE (Caballero et al., 2013), the Older People's Quality of Life Questionnaire (OPQOL) (Bowling, 2009) and the CASP-19 (Control, Autonomy, Self-realisation, Pleasure) (Hyde, Wiggins, Higgs, & Blane, 2003). We have chosen to use the WHOQOL-OLD for measuring quality of life because of multiple reasons. Recently the psychometric properties WHOQOL-OLD were established in a Dutch older population and both the validity and reliability of the instrument was good (Gobbens & van Assen, 2016). In addition, the WHOQOL-OLD contains items referring to death and dying and intimacy that are lacking in the other quality of life measurement instruments, so we recommend using this instrument for assessing quality of life in older people.

Some limitations of this study should be noted. First, we used a Web-based questionnaire ("Senioren Barometer") for collecting the data. Possibly, this led to selection bias, due to the fact that it was necessary to have Internet access for participation in this study. Second, the cross-sectional nature of the study does not allow strict cause-effect interpretations of the associations between background variables, multimorbidity, frailty components, and quality of life. Third, because of overlap in content between two physical frailty items of the TFI (concerning hearing and vision) and the sensory abilities facet of the WHOQOL-OLD, the association between these is high and not informative.

In conclusion, this cross-sectional study showed that quality of life measured with the WHOQOL-OLD is explained by physical, psychological and social components of frailty, emphasizing the importance of a multidimensional assessment of frailty in older people. Health care and welfare professionals should in particular pay attention to physical inactivity, feeling down and lack of social relations, because their influence on quality of life seems to be the largest.

Conflict of interest

The authors declare that they have no conflict of interest.

Ethical approval

All procedures performed in our study were in accordance with ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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