Exploring the effectiveness of integrated care by distinguishing frailty subpopulations: an individual participant meta-analysis

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Abstract

Background

Evaluation research thus far has shown limited effectiveness of preventive, integrated care interventions for frail older people. A possible explanation could be that frail older people have been perceived as a homogeneous group by both care professionals involved in the interventions and researchers conducting the evaluation research. The aim of the current study is to explore to what extent the effectiveness of eight integrated care interventions in Dutch primary care differ between six profiles of frail older people.

Methods

Eight studies evaluating preventive, integrated care interventions in primary care for community-dwelling frail older people between 2008 and 2012 were included for an IPD-meta analysis. All eight interventions contained identification or screening of frail older people from the GP practice, comprehensive geriatric assessments, care plans and an integrated, multidisciplinary follow-up according to the needs of the older people. The following outcomes were studied in a two-stage IPD-analysis: functional limitations, mental health, social functioning, health-related quality of life and general quality of life.

Results

In total, 8,678 participants were included in the eight studies, the mean age ranged from 74.2 to 83.9 years and the majority of the participants was female. The division of the six frailty subpopulations (relatively healthy; mild physically frail; psychologically frail; severe physically frail; medically frail and multi-frail) strongly differed between the eight interventions. For none of these six frailty profiles significant effects were found of the integrated care interventions on health outcomes.

Conclusions

Acknowledging the heterogeneity of the frail older population by means of frailty profiles did not provide a solid explanation yet why evaluation research thus far could not prove the effectiveness of preventive, integrated care in terms of (traditional) health outcomes. This study points out that the target population of frail older people, integrated care interventions and outcomes in evaluation research should be further aligned.

Background

Despite the high expectations of integrated care, evaluation research thus far showed limited effectiveness of preventive, integrated care interventions for frail older people. Integrated care seeks to achieve seamless and continuous care, tailored to the frail older patient's needs and based on a holistic view of the patient (Kodner & Spreeuwenberg, 2002; Mur-Veeman, Hardy, Steenbergen, & Wistow, 2003; Nies, 2004). The expectations of integrated care are high and an extensive list of potential aims are presented in the literature such as improving the quality of care and consumer satisfaction, enhancing clinical results, quality of life, system efficiency and cost-effectiveness (Kodner & Spreeuwenberg, 2002; Kodner, 2009). The number of evaluation studies is increasing rapidly in order to explore whether integrated care is able to achieve these aims, Yet, these evaluation studies of integrated care interventions have not shown convincing effects, in particular in terms of health outcomes (Blom et al., 2018; Eklund & Wilhelmson, 2009; Looman, Huijsman, & Fabbricotti, 2018)

Besides the limited effectiveness, research has also revealed that substantial differences exist between the populations of integrated care interventions aiming at frail older people. Populations were all framed as being frail but further examination showed that the populations considerably differed between and within the interventions (Looman et al., 2018). This is caused by the ambiguity of the conceptualization of frailty (Dent, Kowal, & Hoogendijk, 2016). Researchers have distinguished different domains of frailty, (i.e. the physical, psychological and social domain) (Gobbens, Luijkx, Wijnen-Sponselee, & Schols, 2010; Markle-Reid & Browne, 2003) but this distinction does not fully acknowledge the complexity of frailty yet. Research showed that the more heterogeneous a population is, the more difficult it is to achieve effectiveness (Ferrucci et al., 2004; Lette, Baan, van den Berg, & de Bruin, 2015). Thus, a possible explanation for the limited effects of integrated care interventions could be that frail older people have been perceived as a homogeneous group by both care professionals involved in the interventions and researchers conducting the evaluation research.

In previous research on the evaluation of integrated care interventions sub*groups* of frail older people have been distinguished. However, these subgroups were solely based on dichotomies such as male versus female, low versus high educational level (Drubbel, 2014) or worse versus better baseline situation (Blom et al., 2018; Metzelthin et al., 2013; Stuck, Egger, Hammer, Minder, & Beck, 2002). We argue that by acknowledging the heterogeneity of frailty with subpopulations of frail older people

- based on problems in different domains and the severity of these problems -, more insights can be provided in the potential effectiveness of integrated care interventions. Subpopulations within this heterogeneous population of frail older people could reveal constellation of problems - not only of physical but also of psychosocial problems - and go beyond these dichotomous subgroups. Frailty subpopulations were distinguished with latent-class analysis based on physical, psychological, social and cognitive domain of functioning (Looman et al., 2018). The results showed that frail older people cannot be perceived as a homogeneous population. Six profiles were distinguished (see box 1) ranging from relatively health to extremely frail. In four profiles the problems were mostly limited to one specific domain (either physical or psychological) and in two profiles were multidimensional with a combination of problems that extended to the social and cognitive domain.

The aim of this study is to explore to what extent the effectiveness of integrated care interventions differ between the profiles of frail older people. In other words: is integrated care (more) effective for specific frail older people? As part of the National Care for the Elderly Programme in the Netherlands, eight preventive, integrated primary care interventions were evaluated. However, an IPD-analysis of these interventions did not show convincing effects (Blom et al., 2018). In the current study the IPD-analysis of Blom and colleagues will be replicated for each of the frailty profiles separately (see figure 8.1).

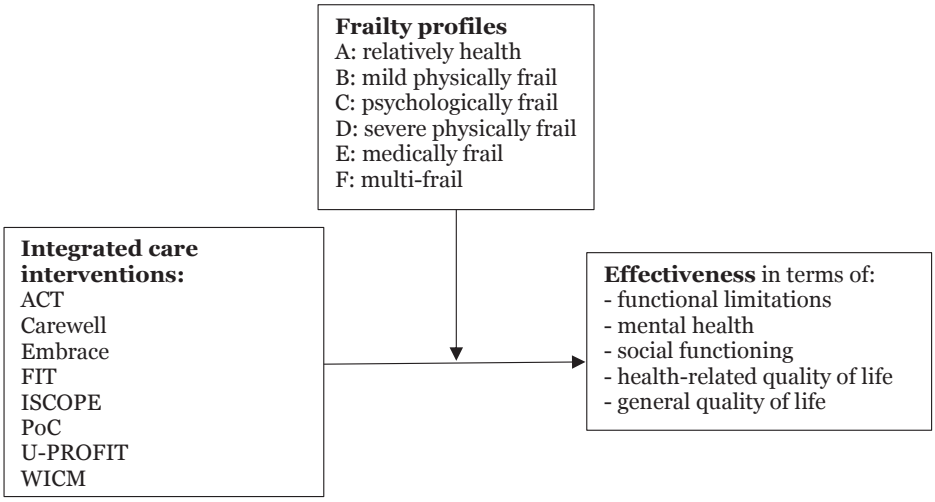

Figure 8.1: Conceptual model

Box 8.1: Descriptions of profiles of frailty

Profile A: '*Relatively healthy*'
Older people in profile A report **good health** and state that their health is **about the same** compared to a year ago. They experience **no** problems with cognitive functioning. They have problems with social activities **none of the time**. Their mean score on mental health is **83**[1]**.** They have **1.7**[2] morbidities and **0.6**[3] functional limitations.

Profile B: '*Mild physically frail*'
Older people in profile B report **good to fair health** and state that their health is **about the same to somewhat worse** compared to a year ago. They experience **no** problems with cognitive functioning. They have problems with social activities **none to little of the time**. Their mean score on mental health is **78**[1]. They have **3**[2] morbidities and **4.6**[3] functional limitations.

Profile C: '*Psychologically frail*'
Older people in profile C report **fair health** and state that their health is **somewhat worse to about the same** compared to a year ago. They experience **no to some** problems with cognitive functioning. They have problems with social activities **little to some of the time**. Their mean score on mental health is **65**[1]. They have **3.2**[2] morbidities and **1.3**[3] functional limitations.

Profile D: *'Severe physically frail'*
Older people in profile D report **fair to good health** and state that their health is **somewhat worse to about the same** compared to a year ago. They experience **no to some** problems with cognitive functioning. They have problems with social activities **none, little to some of the time**. Their mean score on mental health is **70**[1]. They have **3.8**[2] morbidities and **8.3**[3] functional limitations.

Profile E: *'Medically frail'*
Older people in profile E report **fair to poor health** and state that their health is **somewhat to much worse** compared to a year ago. They experience **no to some** problems with cognitive functioning. They have problems with social activities **some, most to all the time**. Their mean score on mental health is **51**[1]. They have **5.2**[2] morbidities and **4.9**[3] functional limitations.

Profile F: *'Multi-frail'*
Older people in profile F report **fair to poor health** and state that their health is **somewhat to much worse** compared to a year ago. They experience **some to severe** problems with cognitive functioning. They have problems with social activities **most to all the time**. Their mean score on mental health is **60**[1]. They have **4.5**[2] morbidities and **12.2**[3] functional limitations.

[1]Mental health: 0 – 100, higher scores represent better mental health.
[2]Morbidities: 0 – 17 self-reported morbidities.
[3]Functional limitations: 0 – 15 limitations in (instrumental) activities of daily living

Methods

Design

In 2008, the Dutch Ministry of Health, Welfare and Sports started the National Care for the Elderly Programme (NCEP) which aimed at reorganizing health and social care according to the needs of older people. Between 2008 and 2014 several implementation and research projects were carried out and funded by the NCEP. Eight studies evaluating preventive, integrated care interventions in primary care for community-dwelling frail older people between 2008 and 2012 were included for an IPD-meta analysis (for a detailed description of the IPD-analysis, see (Blom et al., 2018)). These eight included studies were Care in Transition study (ACT) (Muntinga et al., 2012), the CareWell-primary care program (Ruikes et al., 2012), the Embrace-study (Spoorenberg et al., 2013), the Function In Transition study (FIT) (Suijker et al., 2012), the Integrated Systematic Care for Older PEople study (ISCOPE) (Blom et al., 2016), the Prevention of Care study (PoC) (Metzelthin, van Rossum, de Witte, Hendriks, & Kempen, 2010), the Utrecht primary care PROactive frailty intervention trial (U-PROFIT) (Bleijenberg et al., 2012) and the Walcheren Integrated Care Model study (WICM) (Fabbricotti et al., 2013). The eight interventions studies had controlled designs with before and after measurements, including randomized cluster, individually or stepped wedge, or quasi-experimental designs. The number of respondents in the studies ranged from 346 (PoC) to 2283 (FiT). The follow-up period for the IPD-analysis was 12 months. Researchers in all eight projects collected the data consistent with The Older Person and Informal Caregiver Survey Minimum Dataset (TOPICS-MDS), a national, uniform dataset was created (see (Lutomski et al., 2013). TOPICS-MDS is a fully anonymized dataset available for public access, and therefore the analysis in this study is exempt from ethical review (Radboud University Medical Centre Ethical Committee review reference number: CMO: 2012/120) (Lutomski et al., 2013).

Interventions vs care as usual

The eight interventions were described according to Valentijn's Rainbow model (Valentijn, Schepman, Opheij, & Bruijnzeels, 2013), consistent with the intervention descriptions in the systematic review in chapter 6. All eight interventions contained the following elements: identification or screening of frail older people from the GP practice, comprehensive geriatric assessments, care plans and an integrated, multidisciplinary follow-up according to the needs of the older people (see the supplementary table 8.1 in the appendix). However, the specific content of these elements differed between the interventions. All interventions had a preventive approach and screened frail older people from the GP patient population with a broad approach to frailty,

including the physical, psychological and social domains of functioning. However, the screening methods differed between the interventions. Half of the interventions used two-steps screening (Bleijenberg et al., 2012; Muntinga et al., 2012; Ruikes et al., 2012; Spoorenberg et al., 2013), whereas in the other half of the intervention one instrument was used. In two interventions, frailty was identified by the GP (Muntinga et al., 2012; Ruikes et al., 2012) and in one intervention information from the Electronic Medical Record was analyzed (Bleijenberg et al., 2012). Questionnaires were used in most interventions, including PRISMA (Muntinga et al., 2012), Intermed (Spoorenberg et al., 2013), ISAR-PAR (Suijker et al., 2012), EASYCARE-TOS (Ruikes et al., 2012), ISCOPE questionnaire (Blom et al., 2016) and the Groningen Frailty Indicator (Bleijenberg et al., 2012; Fabbricotti et al., 2013; Metzelthin et al., 2010; Spoorenberg et al., 2013). Comprehensive geriatric assessment in all interventions addressed a wide range of topics such as physical functioning, mood and depression, social participation, and cognitive decline. The assessment was translated into a care plan. The priorities in the care plan were sometimes determined by the older people and their informal caregivers (Blom et al., 2016; Fabbricotti et al., 2013; Metzelthin et al., 2010; Suijker et al., 2012).

The follow-up to the care plan differed between the interventions, with multiple follow-up visits (Suijker et al., 2012), evidence-based interventions (Bleijenberg et al., 2012) or case management (Fabbricotti et al., 2013; Metzelthin et al., 2010; Ruikes et al., 2012; Spoorenberg et al., 2013). The teams responsible for the follow-up in the interventions consisted at least of the GP and practice nurse but in some interventions other professionals were involved such as elderly care physician, social worker, occupational therapist and physiotherapists. All interventions educated the professionals for the interventions on specific elements such as using the assessment, developing the care plan or stimulating patient empowerment. Organizational integration was limited; two networks were set up (Fabbricotti et al., 2013; Muntinga et al., 2012), and financial integration was absent.

Functional integration was applied more extensively. In half of the interventions, multidisciplinary meetings were organized (Fabbricotti et al., 2013; Muntinga et al., 2012; Ruikes et al., 2012; Spoorenberg et al., 2013) and protocols were developed for specific geriatric problems, either evidence-based (Bleijenberg et al., 2012; Metzelthin et al., 2010; Muntinga et al., 2012; Suijker et al., 2012) or focused on multidisciplinary collaboration (Fabbricotti et al., 2013). Moreover, in half of the interventions, professionals used an information system (Fabbricotti et al., 2013; Muntinga et al., 2012; Ruikes, Meys, & Wetering, 2012; Spoorenberg et al., 2013) and normative integration occurred in half of the interventions, mostly by training

sessions or workshops (Bleijenberg et al., 2012; Metzelthin et al., 2010; Ruikes et al., 2012; Spoorenberg et al., 2013).

Compared to these eight interventions, care as usual in the Netherlands is reactive, fragmented and has a monodisciplinary focus. Frail older people consult their GP at their own initiative and for specific health problems. In the Dutch health care system, the GP is gate keeper and refers patients to primary, secondary and tertiary echelons (Boot & Knapen, 2005). Moreover, care as usual is fragmented because care is delivered monodisciplinary and communication between professionals from different disciplines is scarce and bilateral through referral letters or telephonic consultations.

Outcome measures

Five outcome measures from the TOPICS-MDS were considered. *Functional limitations* were measured with the Katz-15 instrument that assesses the ability to perform 15 basic and instrumental activities of daily living (yes/no) such as getting dressed, shopping and taking medication (Laan et al., 2014; Weinberger et al., 1992). The number of activities that respondents were unable to perform were summed, ranging from 0 – 15 with a higher score indicating more functional limitations. *Health-related quality of life* was measured with the EQ-5D, which focuses on health-related quality of life and includes five dimensions: mobility, self-care, daily activities, pain/discomfort and mood (Krabbe, Stouthard, Essink-Bot, & Bonsel, 1999; Lamers, McDonnell, Stalmeier, Krabbe, & Busschbach, 2006). For the general measure of *quality of life* the Cantril's Self Anchoring Ladder was used (Cantril, 1965). *Mental health* was measured using a five-item RAND-36 scale with items that question how often the respondents have felt nervous, calm and peaceful, down-hearted and blue, happy, and so down in the dumps nothing could cheer them up. The score of this scale ranges from 0 – 100 and a higher score implies a better mental health (van der Zee & Sanderman, 1993). *Social functioning* was measured with one item with which was asked how often social activities were hampered by physical health or emotional problems. The possible answers were: none of the time, a little of the time, some of the time, most of the time, all of the time (van der Zee & Sanderman, 1993).

Methods of analysis

The study population of each of the eight evaluation studies was described in terms of background variables (gender, age, marital status, living arrangement, educational level and frailty subpopulations) and outcome measures at baseline. Frequencies and percentages were presented for the categorical variables; means and standard deviations were presented for the continuous variables.

A two-stage IPD analysis was performed. The first step was the analysis of each of the eight interventions and for each of the six profiles separately. The four continuous outcome variables (functional limitations, health-related quality of life, general quality of life, mental health) were analysed with Linear Mixed Models of repeated measures and the categorical variable (social functioning) with Generalized Estimated Equations. In all models time, intervention (experimental or control group) and the interaction time x intervention were included and we adjusted for age, sex and clustering of GP practices. The second step was presenting the pooled outcome for each of the six profiles separately with a random-effect model, weighting with the individual standard errors. The significance level was set at $p<0.05$. The analyses were performed with SPSS and STATA.

Results

In table 8.1 the characteristics of the total 8,678 participants are presented per study. The mean age ranged from 74.2 to 83.9 years and the majority of the participants was female. Most of the older people lived independently and alone, either being widowed or single.

The mean functional limitations varied between 1.52 and 5.08 (theoretical range 0-15). On a scale from 0 to 100, the mean score on mental health ranged from 59.5 to 71.0. Social functioning was frequently hampered by 16.8 to 31.5 percent of the frail older people in the eight interventions. The mean health-related quality of life ranged from 0.57 to 0.68 (theoretical range 0-1). General quality of life was rather stable with a mean of approximately 7 in all interventions.

The division in frailty subpopulations strongly differed between the interventions. For example, the percentage of *'relative healthy'* participants in profile A ranged from 9.2% (PoC) to 62.5% (FIT). The percentage of '*psychologically frail*' older people differed between the interventions, with a relative high percentage in PoC, U-PROFIT and Embrace. The percentage of participants belonging to the multi-frail subpopulation F was low in all eight interventions so we were unable to perform the IPD-analysis for this subpopulation. For none of the six profiles the effect of integrated care on functional limitations, mental health, social functioning, health-related quality of life and general quality of life was significant (see table 8.2). Also for the WICM, the main intervention in this thesis, no significant effects were found.

Table 8.1: Characteristics of the participants

	ACT n=1147	Carewell n=536	Embrace n=602	FIT n=2283	ISCOPE n=1,104	PoC n=346	U-PROFIT n=2214	WICM n=446
N experimental & control group	groups 1:456; 2:227; 3:238; 4:226	E:287; C:249	E:309; C:293	E:1209; C:1074	E:866; C:238	E:193; C:153	E:1,384; C:830	E:221; C:225
Age in years (mean, SD)	80.49 (7.53)	81.88 (5.93)	81.89 (5.00)	82.17 (6.41)	83.86 (5.43)	77.89 (5.11)	74.24 (8.42)	82.82 (5.08)
Female - %	66.5	65.7	66.1	64.0	73.6	57.5	57.4	64.4
Educational level								
low	33.6	45.5	59.0	34.2	38.6	35.3	34.9	55.5
high	66.4	54.5	41.0	65.8	61.4	64.7	65.1	44.5
Marital status - %								
married/living together	37.6	38.8	47.4	46.4	28.3	47.4	58.1	41.0
widowed/not married/divorced	62.4	61.2	52.4	53.6	71.7	52.6	41.9	59.0
Living situation - %								
independently	92.1	100	79.2	87.1	84.5	93.4	99.9	83.0
residential care/nursing home	7.0		20.8	12.9	15.5	6.6	0.1	17.0
Subpopulations:								
A: relatively health - %	15.8	13.8	17.8	62.5	11.8	9.2	38.8	23.3
B: mild physically frail - %	22.5	37.5	17.0	7.0	21.7	12.4	8.9	19.9
C: psychologically frail - %	27.1	15.1	38.9	20.9	25.9	40.2	39.3	23.5
D: severe physically frail - %	12.7	20.3	10.5	3.3	18.5	10.4	3.1	13.2
E: medically frail - %	19.3	9.5	13.8	4.8	15.8	25.1	9.3	15.7
F: multi-frail - %	2.6	3.7	2.0	1.4	6.3	2.6	0.7	4.5
Functional limitations (0-15) (mean, SD)	3.92 (2.78)	5.08 (2.84)	3.29 (2.85)	3.21 (3.00)	4.65 (3.34)	3.12 (3.01)	1.52 (2.05)	4.02 (3.30)
Mental health (0-100) (mean, SD)	67.70 (20.59)	71.00 (19.52)	67.22 (0.16)	70.79 (17.49)	66.48 (18.40)	59.50 (17.53)	70.36 (18.62)	70.69 (17.65)
Social function hampered a little of none of the time - %	45.7	61.3	50.1	54.8	78.3	39.3	56.0	59.0
Health-related quality of life (0-1) (mean, SD)	0.60 (0.28)	0.60 (0.30)	0.68 (0.16)	0.74 (0.22)	0.57 (0.30)	0.64 (0.27)	0.74 (0.23)	0.63 (0.27)
Quality of life (0-10) (mean, SD)	6.98 (1.30)	7.04 (1.23)	6.60 (1.32)	7.17 (1.24)	6.79 (1.38)	6.57 (1.28)	7.17 (1.28)	6.99 (1.15)

Table 8.2 Outcomes of the IPD-analysi:s for each of the six frailty profiles

Outcome measures - *Patient outcomes (mean change over 12 months)*	Adjusted mean difference between intervention and usual care (95% CI)				
Frailty profiles	Functional limitations[1]	Mental health[2]	Social functioning[3] - OR	Quality of life[4] – health related	Quality of life[5] – general
A: relatively health	-0.02 (-0.12; 0.10)	-0.05 (-1.16; 1.07)	1.00 (0.79; 1.27)	-0.01 (-0.03; 0.01)	-0.02 (-0.10; 0.06)
B: mild physically frail	-0.08 (-0.34; 0.18)	-0.13 (-1.85; 1.58)	0.88 (0.65; 1.19)	-0.02 (-0.05; 0.01)	0.07 (-0.14; 0.28)
C: psychologically frail	0.01 (-0.14; 0.16)	-0.64 (-1.89; 0.60)	1.07 (0.87; 1.32)	0.00 (-0.02; 0.02)	0.02 (-0.10; 0.13)
D: severe physically frail	-0.02 (-0.46; 0.45)	0.59 (-2.38; 3.56)	0.82 (0.43; 1.55)	0.02 (-0.03; 0.06)	-0.03 (-0.25; 0.19)
E: medically frail	0.24 (-0.07; 0.54)	0.02 (-2.31; 2.34)	1.33 (0.90; 1.96)	0.00 (-0.03; 0.04)	-0.06 (-0.27; 0.16)
F: multi-frail	-	-	-	-	-

[1]Modified Katz scale, higher scores represent more functional limitations;
[2]RAND Mental Health Subscale, higher scores represent better mental health;
[3]RAND item social functioning; hampered a little or none of the time vs hampered some of the time; mostly and all of the time.
[4]EQ-5D, higher scores represent better health-related quality of life
[5]Cantril's Self Anchoring Ladder, higher score represents better quality of life

Discussion

Despite the high expectations of integrated care, evaluation research thus far has shown limited effectiveness of preventive, integrated care interventions in primary care for community-dwelling frail older people. A possible explanation for the limited effects could have been that frail older people are a heterogeneous group which is not fully acknowledged in the evaluation research on integrated care. Therefore, in the current study, insights of two previous studies were combined in order to explore whether integrated care is effective for specific subpopulations of frail older people. An IPD-analysis of eight integrated care interventions from the NCEP was replicated (see also (Blom et al., 2018)) for six frailty profiles as distinguished in previous research (Looman et al., 2018). The results showed that the subpopulations of frail older people do not moderate the effectiveness of eight integrated, primary care interventions or the WICM. For none of the subpopulations, integrated care was effective in terms of five health functional limitations, mental health, social functioning, general quality of life and health-related quality of life.

The results confirmed that frail older people are indeed a heterogeneous population. Heterogeneity of the population of frail older people exists within and between pri-

mary integrated interventions. The distribution of subpopulations strongly differed between the study populations of the eight preventive, integrated care interventions in our study. This is related to the screening methods as is shown by the differences in distributions of the subpopulation FIT intervention (using the ISAR-PAR which is a short instrument with three questions on IADL activities, memory loss and age (Suijker et al., 2012)) and the PoC, using the Groningen Frailty Indicator (a 15 item questionnaire on The GFI is a 15-item questionnaire that measures decreases in physical, cognitive, social, and psychological functioning (Metzelthin et al., 2010)). However, the screenings instruments do not fully explain the differences between the populations since both PoC (Metzelthin et al., 2010) and the WICM (Fabbricotti et al., 2013) used the Groningen Frailty Indicator to screen for frailty – but with different cut-off points – and the division in frailty subpopulations is still rather different.

Furthermore, our results show that acknowledging this heterogeneity by frailty profiles does not provide a solid explanation for the limited effectiveness of preventive, integrated care on health outcomes of frail older people. This is line with evidence from previous systematic review on integrated care (Eklund & Wilhelmson, 2009; Looman et al., 2018) and the IPD-analysis on the entire population of frail older people and on dichotomous subgroups (Blom et al., 2018). Even though no significant effects were found, still, some tendencies between specific frail older people and the effectiveness of integrated care could be observed. Firstly, when the type and severity of the problems of the frail older people, and thereby the complexity, increased, the effects of integrated care on health outcomes also varied increasingly. The effects of the integrated care interventions were most similar for *relative healthy* older people (profile A) compared to the other five frailty profiles. Secondly, also negative tendencies could be observed for the effects of integrated care within the profiles. This is quite remarkable since in a systematic review no negative effects of integrated care on health outcomes were found for frail older people in general (Looman et al., 2018). However, in the current study distinguishing frailty profiles, a negative tendency was shown of integrated care on mental health for *psychological frail* of profile C. Also for profile E, the *medically frail*, there wa a negative tendency of integrated care on functional limitations. Within this profile E the frail older people have relatively many chronic conditions and this negative effect might point towards medicalisation (Pereira et al., 2015). Thirdly, the severity of frailty also seemed relevant in the effects of integrated care. The results showed differences in the effect of integrated care on health-related quality of life between the two physically frail profiles. Profile B, the *mild physically frail*, tended towards a negative effect, whereas for profile D, the *severe physically frail*, tended towards a positive effect of integrated care on health-related quality.

Strengths and limitations

The main strength of this study is the innovative approach of exploring the effectiveness of integrated care by acknowledging the heterogeneity of the population of frail older people. Our frailty profiles exceed the dichotomy frail – non-frail or the divisions in subgroups, for example worse versus better baseline situation. The six subpopulations show constellations of problems in multiple domains of functioning. The effectiveness of eight Dutch interventions from the NCEP could be explored in an IPD-analysis because the eight interventions were quite comparable, even as the care as usual in the control group. Moreover, all evaluation studies measured the exact same outcomes with the same instruments as prescribed in the TOPICS-MDS. This was a unique opportunity to explore the Dutch context.

The first limitation of our research is that the IPD-analysis was a non-systematic selection of eight interventions in the Dutch context and that the external validity is limited. We can therefore not generalize our conclusions to other countries or make general statements on the effectiveness of integrated care. The second limitation is that some of the subpopulations were rather small. This means that the statistical power was sometimes limited and for profile F – the *multi-frail* - the number were too small to perform the IPD analysis. In the original analysis of the frailty profiles, the profiles were dinstinguished with latent-class analysis based on the entire TOPICS-MDS dataset including hospitalized and institutionalized frail older people (Looman et al., 2018; Lutomski et al., 2013) whereas our IPD-analysis focused integrated primary care interventions in which community-dwelling frail older were preventively screened. The last limitation is that the outcome measures of the IPD-analysis were rather traditional health outcomes such as functional limitations and health-related quality of life. Previous research also showed that the effects of preventive, integrated care on these outcomes is generally limited (Blom et al., 2018; Eklund & Wilhelmson, 2009; Looman et al., 2018). These (traditional) outcomes were agreed upon for the TOPICS-MDS within the NCEP; however, since the development of the TOPICS-MDS (Lutomski et al., 2013), research has gradually shifted towards other outcomes related to well-being and positive health (Huber et al., 2011; Huber et al., 2016; Linton, Dieppe, & Medina-Lara, 2016). Two outcomes in this study were quality of life outcomes but these were health-related quality of life (Krabbe et al., 1999; Lamers et al., 2006) and general quality of life measured with a single item (Cantril, 1965). Research showed that health-related quality of life seems less appropriate for frail older people (Comans, Peel, Gray, & Scuffham, 2013) and well-being is more nuanced and related to specific domains, such as love and friendship and doing things that make you valued (Coast et al., 2008; Grewal et al., 2006; Nieboer, Lindenberg, Boomsma, & Bruggen, 2005).

Recommendations

The first implication of our research is that heterogeneity of frailty should be further explored in order to gain better insights in improving the effectiveness of integrated care aimed at frail older people. Heterogeneity enables to identify specific needs of frail older people by acknowledging both their deficits *and* assets. Also in evaluation research of integrated care, the heterogeneity of frail older population should become more prominent. Our research shows that overall effects of integrated care might be absent because both positive and negative effects emerge that might level each other out. Moreover, when complexity of the problems of frail older people increases, the effects of the intervention became more mixed. Further specification of frailty could provide better understanding in the potential effects of integrated care on frail older people. Even though our six frailty profiles were a promising starting point, future research might apply more narrow segmentation. The second implication is that the integrated care interventions itself should be properly aligned to the needs of frail older people. The integrated care interventions in these studies were complex interventions consisting of many different components such as screening, geriatric assessments, follow-up, case management, multidisciplinary meetings and protocols. However, these elements might not be necessary for all (profiles of) frail older people, since also negative tendencies emerged in our study. Also the specific content of the integrated care interventions should be aligned to the needs of frail older people. The eight interventions had a strong medical approach since all were situated in Dutch primary care practices with an important role for the GP and practice nurse. A third and last implication is that the effects of subpopulations on the effectiveness of integrated care should also be studied for other types of outcomes, including well-being and outcomes related to positive health.

Conclusions

The heterogeneity and complexity of the frail older population should be further acknowledged, both between and within integrated care interventions. Yet, acknowledging this heterogeneity by means of frailty profiles did not provide a solid explanation yet why evaluation research thus far could not prove the effectiveness of preventive, integrated care in terms of (traditional) health outcomes. This study points out that the alignment between the target population of frail older people, integrated care interventions and outcomes in evaluation research should improve.

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Supplementary table 8.1

Name intervention	Short description intervention	Focus intervention/ primary outcome
ACT	Consisted of the following components: a regularly scheduled in-home comprehensive geriatric assessment by a practice nurse, followed by a customized care plan, management and training of practice nurse by a geriatric expert team, and coordination of care through community care network meetings and multidisciplinary team consultations of individuals with complex care needs.	Target health risks and care needs at an early stage, stimulate active involvement of older adults in the care process, improve coordination between professionals
CareWell	General practitioner-led extensive, multicomponent program integrating cure, care and welfare for the prevention of functional decline.	Prevention functional decline
Embrace	Embrace encompasses an Elderly Care Team per general practitioner practice, an Electronic Elderly Record System, decision support instruments, and a self-management support and prevention program – combined with care and support intensity levels.	Primary patient outcomes: complexity of care needs, frailty, health status, and self-management ability. Primary caregiver outcome: caregiver burden.
FIT	Comprehensive geriatric assessment and individually tailored care treatment plan consisting of multifactorial interventions based on standardized evidence-based protocols, and nurse-led care coordination with multiple follow-up visits	Primary outcome: physical functioning.
ISCOPE	Multidisciplinary integrated care plan using a functional approach delivered by the GP and PN. Training in functional approach and care plan, 3 sessions of 2 hours each.	Quality of life, activities of daily living
PoC	Multidimensional assessment and interdisciplinary care based on a tailor made treatment plan and regular evaluation and follow-up.	Participation in social and productive activities
UPROFIT	U-PRIM, a frailty screening intervention based on routine care data, and of U-PRIM followed by U-CARE, a nurse-led personalised care intervention.	Preserving daily functioning
WICM	Pro-active screening for frailty, assessment of care needs, GP practice as single entry point from which case management was provided, GP as coordinator of care, and the process was supported by multidisciplinary meetings, protocols and web-based files.	Improve quality of life

	Service integration (micro-level)				
Name intervention	**Identification/screening of frail older people**	**Assessment**	**Care plan**	**Follow-up**	**Single entry point**
ACT	2 consecutive steps:1) Identification of frail persons by the GP (frail=experiencing one or more limitation in either physical, psychological and/or social areas); 2) PRISMA-7 questionnaire score > 3 (a score of > 3 was considered as frail)	Yes comprehensive	Yes, developed by nurse with primary care physician	Guideline-concordant management and treatment options, involve older adults in decision-making process, evaluate of care plan	
CareWell	EasyCare-TOS instrument	Yes	Yes, revised during team meetings	Case management by nurse or social worker: coordinate and monitor care, plan team meetings, acknowledge participants of care plan, involve participants in settings goals, maintain contact with participants and informal caregiver, hold a medication review (by ≥5 chronically prescribed drugs)	
Embrace	Identification based on complexity of care needs [INTERMED Elderly Self-assessment (IM-E-SA)], and level of frailty measured with the Groningen Frailty Indicator (GFI) into risk profiles: A) robust, B) frail, C) complex care needs. B and C included in this study.	Yes, history questionnaire to identify problems on physical functioning, performance of activities, social participation and living environment	Yes, care and support plan with information about goal setting, actions performed and evaluations	Case management by practice nurse or social worker, navigating through complex care process, monitor changes in the medical, psychosocial, or living situation and navigates the plan's delivery. Close contact with professionals and volunteers. Care plan is discussed every month.	
FIT	ISAR-PC: Identification of Seniors at Risk-Primary Care	Yes, comprehensive geriatric assessment to systematically identify geriatric conditions, problems and needs. CGA focuses on physical, psychological, functional and social domains with validated instrument and physical examination.	Individually tailored care and treatment plan (CTP), priorities in consultation with the older people and informal caregivers.	Multiple follow-up visits, nurse-led coordination. Evaluation of CTP and interventions; prioritizing geriatric conditions, social functioning and participation, burden and needs of caregiver, participants needs and expectations. Nr of home visits is flexible range between 3 and 8. Nurse maintains contact with other health care professionals (occupational therapists, physiotherapists, welfare consultants) and caregiver.	

	Service integration (micro-level)				
Name intervention	**Identification/screening of frail older people**	**Assessment**	**Care plan**	**Follow-up**	**Single entry point**
ISCOPE	ISCOPE-screening questionnaire with 4 domains of health: functional, somatic, psychological, social: >2 domains of health positive included.	Inventory of existing health problems in problem areas: somatic, activities daily living, social, mental and communicative problems. Wishes and expectations of older person about goals to be achieved were explored with participant and informal caregiver.	Multidisciplinary integrated care plan using a functional approach, priorities and goals of the older person as starting point.	The GP/practice nurse, together with the older person, formulated actions to be taken and evaluation plans for follow-up. Other care professionals were involved where needed (multidisciplinary consultation)	
PoC	Screening Groningen Frailty Indicator >4	Yes, multidimensional: Problems daily activities, risk factors daily activities	Yes, formulated with frail older person	Case management by practice nurse: executing treatment plan with intervention protocol and toolbox of interventions, evaluation of achievement of goals, implementation of strategies in daily life, need of support in the following period, update other professionals	
UPROFIT	Screening with automated analysis of electronic medical record (EMR) data: Multimorbidity (frailty index score of ≥ 0.20); AND/OR; Polypharmacy (chronic use of ≥ 5 medications) AND/OR; Consultation gap in primary care of ≥3 years	Yes, two-stage: Frailty & bio-psychosocial needs; comprehensive (falls & mobility, physical functioning, nutrition and malnutrition, cognitive decline, polypharmacy, mood & depression, loneliness, vision problems & hearing loss, urinary incontinence, caregiver burden)	Yes, developed by practice nurse and GP	Interventions from evidence-based care plan for all ten health problems (e.g. polypharmacy: multifactorial interventions; tailored patient education, instruction, support, feedback and follow-up; tools and reminders for adherence)	
WICM	Screening Groningen Frailty Indicator>3	Yes, comprehensive: Activities daily life, cognition, mood, support care givers	Yes, formulated in consultation with frail older people and informal caregiver, developed by case manager, approved in multidisciplinary meeting	Case management by practice nurse: coordinate care, monitoring, admittance to services, contact person for professionals, evaluating treatment plan, follow-up at least every 6 months	Yes

	Professional integration (meso-level)				Organizational integration (meso-level)	System integration (macro-level)
Name intervention	**Focal organisation**	**Role GP**	**Team composition**	**Education professionals**	**Organizational integration**	**Financial integration**
ACT	Primary care practice	Part of team	Practice nurse, GP, geriatric expert team (experienced geriatric nurse and an elderly care physician), pharmacists, other health care professionals could be consulted	Practice nurse: motivational interviewing course, workshop on assessment tool, management and training by expert team. Geriatrician: workshop on assessment tool	Regional network of organizations: providers of care services for older adults, primary care professionals, community-based organizations	
CareWell	GP practice		Core multidisciplinary team: GP, practice nurse or community nurse, elderly care physician, social worker	Persuasive communication and social influencing for participation, provision of additional information through a website, newsletters and written instructions, providing feedback and advice to the participating professionals		No - Financial reimbursement for all health care professionals and organizations to cover the extra efforts required by the program, to facilitate participation in the intervention
Embrace	GP practice		Elderly Care Team: GP, elderly care physician, case managers (district nurse and social worker)	Intensive training program on working according to the intervention (pro-active team work, prevention, and working with the information system. Casemanagers: training on individual and group self-management interventions. GP: manage their team and on providing care and support on problems as multimorbidity,. Project leader: training and support on the job.		
FIT	GP practice	Registered nurse works in close collaboration with GP. GP is formally responsible.	GP and registered nurse	10-day training program on content and use of study protocol, CGA, design and apply individually tailored CTP. Focus on care coordination, patient empowerment and motivational interviewing. Group refresher course every 6 weeks on study protocol and to discuss complex cases.		

	Professional integration (meso-level)				Organizational integration (meso-level)	System integration (macro-level)
Name intervention	**Focal organisation**	**Role GP**	**Team composition**	**Education professionals**	**Organizational integration**	**Financial integration**
ISCOPE	GP practice		GP and PN	GPs and practice nurses were trained (2 sessions of 3 hours) by a GP specialised in geriatric care to deliver proactive integrated care, including designing, conducting and adjusting a care plan. GPs could consult the specialised GP and received extra training on resources and organisation of care.		
PoC	GP practice	Member core team	Core team: General practitioner and practice nurse. Close cooperation: occupational therapists and physical therapists, other professionals (pharmacists, geriatrician)	All professionals: training sessions and meetings on intervention protocol (e.g. screening, assessment), possibility to gain experience with protocol in practice		
UPROFIT	GP practice		GP, practice nurse	Practice nurses: intervention training program 5 weeks of 4 hours on frailty assessment, content assessment, evidence-based care plans. GP and practice nurse: intervention training session 4 hours on content intervention		
WICM	Network of organizations with one single entry point	Coordinator of care, partner in prevention, single entry point	GP, nurse practitioner, second-line geriatric nurse practitioner, geriatric physiotherapists, geriatricians, pharmacists, district nurse, nursing home doctors, mental health workers	GP: training in geriatric care, assessment tool, GP consults. Case manager: training assessment tool, course case management	Network with Joint Governing Board of all involved organizations (GP practices, home care organizations, and nursing homes)	

	Functional integration		Normative integration		
Name intervention	**Coordination**	**Information system**	**Normative integration**	**Role informal caregiver**	**Prevention**
ACT	Guideline-concordant management and treatment options	Digital patient system, tasks geriatric expert team: (quality) management, expert knowledge transfer by team meetings, training sessions and multidisciplinary patient reviews			Identification of frail older people by GP & PRISMA questionnaire; assessment; care plan; follow-up
CareWell	Team meetings every 4 - 8 weeks, multidisciplinary guidelines on 8 common geriatric syndromes, a guideline on advance care planning, procedure agreement for easy-to-access consultation by geriatric experts, and procedure agreement between primary and specialized providers upon hospitalization and discharge	Web-based health and welfare portal	Tailor-made meetings, coaching on the job, helpdesk, and expert meetings to overcome gaps in knowledge, attitude and skills needed to conduct the program		Screening with EasyCare-TOS, assessment; care plan; follow-up
Embrace	Monthly meetings in which the Elderly Care Team evaluates the participants' (health) problems and treatment options. Decision support: triage instrument for stratification and history questionnaires.	Clinical information system with personal health records (individual triage data, history questionnaire, care plan), panel overview and team agenda.	Regular meetings between ECT professionals and project leaders. GP trainings on team management.	(Health) problems and treatment options of caregivers are discussed and evaluated in meetings.	Screening with INTERMED Elderly Self-assessment and GFI into risk profiles, assessment, care plan. Focus on the elderly people central role in their health management and their perspective on care and support needs. Systematic application of effective self-management support strategies such as shared decision making, motivational interviewing, goal attainment, and action planning. Organization of community meetings on need for prevention. endorsing a healthy lifestyle and maintaining self-management abilities.

	Functional integration		Normative integration		
Name intervention	**Coordination**	**Information system**	**Normative integration**	**Role informal caregiver**	**Prevention**
FIT	Multifactorial interventions based on standardized evidence-based protocols for geriatric conditions (goal, step-wise action plan, background information, screening for conditions, diagnostic work-up, evidence-based interventions, financing of care, advice participants, aim of patient empowerment), nurse-led coordination.			Care and treatment plan is discussed with informal caregiver. Burden and needs of caregivers are addressed during home visits.	Identification ISAR-PC, assessment, CTP. Registered nurse enhances empowerment of the participants and caregivers by providing or facilitation psychoeducation on identified geriatric conditions.
ISCOPE				Goals to be achieved were discussed with informal caregiver.	Screening with ISCOPE, inventory health problem, care plan.
PoC	Bilateral or extended team meetings, toolbox of interventions: enhancing meaningful activities, daily physical activity, social network and social activities, adapting environment, activities or skills, and stimulating health		Training sessions and meetings on client-centeredness, interdisciplinary collaboration	Support of social and physical environment, involvement in decision making and cooperative working relationship	Screening Groningen Frailty Indicator; assessment; care plan; follow-up; stimulating health is one of five topics in toolbox of interventions
UPROFIT	Flowchart with suggested evidence-based interventions,		Workshop about collaboration between GP's and practice nurses	Assessment of caregiver burden	Screening of electronic medical record, assessment; care plan; follow-up; screening intervention on falls/mobility, exercise programs that consist of muscle strengthening, balance retraining, endurance and flexibility, motivation, feedback, patient education on physical functioning; screening on nutritional status, patient education on loneliness
WICM	Multidisciplinary meetings, multidisciplinary protocols, web-based files, task reassignment and delegation between nurses and doctors and among GPs, nursing home doctors and geriatricians. Consultation among primary, secondary and tertiary care providers occurred	Web-based files		Explicit attention for support and guidance and informal caregiver, validate care plan with informal caregiver	Screening Groningen Frailty Indicator; assessment; care plan; follow-up; GP is partner in prevention