WHAT WORKS FOR FALL PREVENTION AND CARDIOVASCULAR DISEASE SCREENING

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General introduction

In the Netherlands, almost 20% of the burden of disease can be attributed to lifestyle determinants such as physical inactivity, smoking, an unhealthy diet and alcohol use [1]. Personal determinants like a high blood pressure, high glucose levels and overweight contribute to 15% of the burden of disease [1,2]. These determinants together with an aging population, leads to a high prevalence of age-related chronic diseases such as cardiovascular diseases (CVD) [3,4]. In addition to chronic diseases, the aging population in combination with physical inactivity predicts an increase in the number of fall incidents and recurrent falls [5,6].

Prevalence of CVD and falls

CVD's are the number one cause of death, worldwide and within Europe [7,8]. In Europe, CVD leads to around 4 million deaths each year [8,9], accounting for 47% of all deaths in women and 39% of all deaths in men [8]. Within the Netherlands, despite the aging population, mortality by cardiovascular disease has declined the last decades [10]. The absolute number of deaths in 2018 was 37.795 [11], which accounted for 25% of all deaths in women and 24% in men [12]. However, in the prevalence of CVD a small increase was found. In 2018, around 1.55 million cases of chronic CVD were registered, which led to more than 255.000 hospital admissions [12]. Therewith, healthcare costs of CVD is high and cover 11.7% of total healthcare costs [13].

Falls are the second leading cause of accidental injury deaths worldwide and older adults (≥65 years) have the highest risk of such a fatal fall [14]. In 2017, within Europe, 54.504 older adults died due to a fall [15]. In the Netherlands, mortality rates of falls increased which led to a total of 4.720 older adults that died due to a fall in 2019 [16,17]. Globally and in the Netherlands, one third of older adults experience a fall each year [5,18-20]. Within the Netherlands, this led to 109.000 emergency department visits, which is equal to one emergency department visit every four minutes. The prognosis is that due to the aging population, the number of fall accidents and severe injuries due to a fall will increase the coming years [20]. Healthcare costs of falls are rising as well and exceeded the one billion euros in 2019, which cover 1% of total healthcare costs [17].

Prevention

There is an ever-growing emphasis on prevention in healthcare. Also within policy, prevention receives more and more attention which is reflected in several policy documents. The Dutch government published in collaboration with more than 70 national organizations, the 'National Prevention Agreement' [21]. This agreement focuses on reducing smoking,

overweight and problematic alcohol use to achieve a better health within society. In accordance with the prevention agreement, a dynamic knowledge agenda was published, with the goal to create more coherence in knowledge development and application in the field of prevention [22]. In addition, within the "National Health Policy Memorandum 2020-2024", prevention is an important topic with special attention for reducing the risk of an emergency department visit after a fall [23]. The overall ambition within the Dutch ministry of Health Welfare and Sports is to keep everybody healthy and therewith allow older adults to live at home independently for as long as possible. Specific preventive programs for both the prevention of CVD and prevention of fall incidents can play important roles in realising these ambitions. Increasing physical activity alone can already lead to much improvement of both CVD and fall accidents (figure 1) [24].

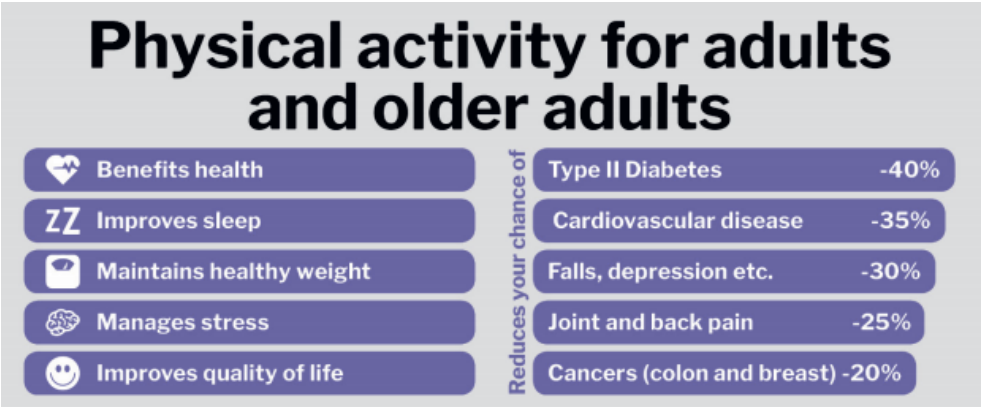

Figure 1. Benefits of physical activity in adults and older adults [24].

Prevention in healthcare

Preventive care has the aim to prevent diseases and health problems and to promote health. To improve preventive care, not only healthcare settings but home care and individuals social network should be involved [25]. Involving multiple settings also gives the opportunity to reach individuals for prevention in different settings by known healthcare providers. The general practitioner (GP) has a central role in providing prevention in healthcare [25,26]. They are familiar with patients' medical history and are therefore ideally suited to provide preventive care [25]. However, it is estimated that the reach of preventive interventions is low. Collaboration with other healthcare professionals and settings is necessary to reach individuals in their own environment [25]. A more active approach for identifying risk can contribute to increasing the reach for prevention programs [27]. A potential setting to do so are in-hospital settings, since they are visited by a potential high risk population for falls as well as CVD. Nevertheless, until now, hospitals are mainly involved in specialized preventive care at a more advanced stage, such as secondary or tertiary prevention [26].

A role in prevention by identifying patients at risk is new. For this thesis, we implemented preventive programs in two different settings. For fall prevention, older adults were reached by a neighbourhood approach with help of local healthcare professionals such as home care and physiotherapist. In addition, a high risk prevention approach that consisted of risk identification within the hospital was implemented for fall risk as well as CVD risk to investigate this new role for prevention in the hospital.

Prevention of CVD and falls

For the prevention of CVD, interventions focussing on promoting a healthy lifestyle are recommended [28]. Modifiable risk factors such as smoking cessation, weight management and healthy blood values can reduce the risk of developing or aggravating CVD [29,30]. For patients at very high risk and within secondary prevention, in addition to a healthy lifestyle, pharmacological treatment is also recommended [30]. Despite that a population based approach is often advocated, a high risk approach can make an important contribution in the prevention of CVD [31,32]. There are numerous guidelines for preventing CVD by risk profiling [30,33,34]. When prevention guidelines are adhered to and health risk behaviours are eliminated, the prevalence of CVD could be reduced by 80% [30].

Falls are associated with several risk factors of which most can be addressed by prevention, such as impaired balance, the use of medication, poor visibility and environmental factors such as loose paving [35,36]. There are several effective fall prevention interventions that can prevent both the risk of falling and injuries caused by a fall. Dependent on the type of intervention, fall prevention can reduce the risk of falling by 20-40% [37]. Despite the multifactorial cause of a fall, interventions with at least two exercise components are most effective when it comes to reducing fall rates, fall related injurious and serious injuries [37-41]. Exercise interventions can reduce fall injuries by 37% and severe injuries by 43% [41]. However, fall risk and prevention is often not discussed with the healthcare provider, not even when a fall has already occurred in the past [42]. Older adults see a fall accident as part of aging and not as something they can prevent. Awareness about their risk and knowledge about prevention are necessary to reduce falls and fall related injuries. The British as well as the American Geriatrics Society recommend screening patients at least annually on their fall risk [43]. Within the Netherlands screening is also advised, and a screening instrument was developed by VeiligheidNL to assess fall risk among community dwelling older adults [44].

Implementation

Despite the growing attention on prevention in healthcare and existing evidence based interventions and guidelines, implementation within current healthcare systems remains difficult and understudied [37,45]. However, the effectiveness of preventive interventions

relies also on the implementation of the intervention. Therefore, understanding the critical conditions of implementation is important. Perceived barriers and facilitators can affect implementation of preventive interventions at any time [46]. Factors can be presented as potential barriers, but when successfully managed, these same factors can facilitate the implementation process. For instance, when knowledge about preventive actions is lacking among healthcare providers, knowledge will impede implementation. On the other hand, when healthcare providers have sufficient knowledge about preventive actions, it can facilitate implementation. Gaining insight in these critical conditions for preventive interventions can help with addressing the right factors for successful implementation.

In-hospital setting

For successful implementation of in-hospital preventive interventions of CVD and fall risk, perceptions of patients as well as healthcare providers are important. It is under discussion whether identification is always at best interest for the patients. Some argue that knowing the potential risk of developing a disease can negatively affect quality of life, so it might be better not to know. Besides, patients see involvement of healthcare providers as giving up their autonomy [47,48]. However, when patients have participated in screening, most see it as a simple general health check and have no trouble with screening [49]. When it comes to preventive screening within the hospital, little is known about the barriers and facilitators that patients experience. Once programs focusing on prevention are performed, actions to reduce risk are not always executed by patients. Therefore, evaluating the effect of preventive interventions in terms of uptake and preventive actions performed by patients is critical information to optimize implementation of these interventions. In addition, healthcare providers have an important role in the successful implementation of preventive interventions. Therefore, it is also important to identify barriers and facilitators they experience. Healthcare providers believe in the importance of guidelines and prevention [50,51], but still experience barriers that impede implementation such as knowledge, a lack of financial support, facilities and the infrequent use of guidelines [50,52-54]. However, most of these studies focus on prevention in primary care settings. For the implementation of preventive interventions in the hospital, perceptions healthcare providers experience and actions they take after following a guideline in a hospital setting are largely unidentified.

Community setting

In a community setting, participation of older adults in exercise fall prevention programs is low [55]. Dutch healthcare professionals estimate that only 0-40% of the older adults with a high fall risk are referred to an exercise program [56]. Often only those older adults who express their concerns about falling are screened for fall risk [57], while in general patients prefer that a healthcare provider takes the initiative [58]. When fall prevention is offered, personal factors are among the reasons to reject these programs [59,60]. Studies found that older adults favour programs of low intensity, free of charge and programs that are

home based. Furthermore, giving participants a choice for a program is a facilitator for the implementation of fall prevention [61,62]. However, it is unknown if there are factors or preferences that really increase participation rates of fall prevention in community settings and thus facilitate successful implementation of fall prevention in a community setting.

Studies

For this thesis, I used two studies that focussed on different settings were prevention is integrated in somebody's daily life. I used the data of the 'Koers18 Erasmus MC' study to investigate critical conditions and adherence to prevention programs initiated during regular patients visits to the hospital. Furthermore, I used the 'Houd ouderen op de been' study to investigate conditions and preferences of older adults for participation in fall prevention programs. This study was initiated within older adults' own living environment.

Koers18 program Erasmus Medical Center

The Koers18 prevention project evaluated the use of evidence-based prevention guidelines within the Erasmus Medical Center (Erasmus MC). The US Preventive Services Task Force (USPSTF) recommend 28 protocols on prevention. When the Erasmus MC investigated the use of these recommended protocols in 2015, they found that only seven of these are fully integrated in the hospital guidelines and eight are partly integrated. Screening older adult patients to identify a possibly elevated fall risk and screening for CVD risk for primary and secondary prevention are two of the guidelines that were not yet structurally applied. The Koers18 program aimed to improve prevention within the Erasmus MC by implementing these guidelines in a pilot setting. In this way, the implementation of prevention into daily practice could be evaluated and preconditions for hospital-wide implementation could be examined. The interventions for both CVD prevention and fall prevention consisted of a health risk assessment combined with tailored feedback and preventive advice. After this assessment and preventive advice surveys were conducted among patients and healthcare providers involved to assess the critical conditions for a hospital based prevention program.

Houd ouderen op de been

The 'Houd ouderen op de been' study was designed to improve the participation among older adults within available fall prevention programs in the city of Breda, the Netherlands. Despite that fall prevention programs are available for community dwelling older adults, these interventions are not yet systematically and structurally applied in practice. Older adults experience barriers as: insufficient attention from healthcare providers for fall prevention, insufficient familiarity with opportunities of fall prevention in the neighbourhood and difficulty in sustaining the intervention. With a neighbourhood-oriented and preference

based approach the 'Houd ouderen op de been' study aimed to gain insight into the effect of the implementation on participation rate and compliance.

Aims

The main focus of this thesis is to study conditions for successful implementation of prevention programs. Programs on cardiovascular disease prevention in the hospital setting and programs for fall prevention in the hospital and community setting were selected as illustrative examples.
The aims of this thesis are:

1) To identify the critical conditions for patients and healthcare providers for successful implementation of prevention programs within healthcare
2) To evaluate the successful implementation of prevention programs with respect to:
   a) Patients participation in the programs
   b) Healthcare providers adherence to the programs

Outline of the thesis

The aims will be answered for the two types of settings were prevention is integrated in someone's daily life, namely during regular visits to the hospital or within older adults living environment. **Part I** of the thesis (chapter 2, 3, 4 and 5) describes the implementation of preventive programs in a hospital setting and other healthcare settings involved by referral. Chapter 2 presents the critical conditions that are experienced by older adult patients and healthcare providers when a fall risk screening is performed within outpatient settings of the hospital. Which actions patients take to reduce their fall risk after such a screening within the hospital will be discussed in chapter 3. Chapter 4 covers the critical conditions experienced by patients screened for CVD risk within the hospital and also describes lifestyle changes that these patients made after such a screening. The perspectives of general practitioners involved in this screening and the prevention advice, but also the actions general practitioners carry out after receiving screening results of their patients are presented in chapter 5. **Part II** of the thesis (chapter 6, 7 and 8) describes the implementation of fall prevention programs in a community setting. Chapter 6 evaluates the implementation of a home-based fall prevention program using the RE-AIM framework. Factors that are associated with frequent participation of older adults in such a home-based fall prevention program are discussed in chapter 7. Chapter 8 describes the effect of personal preferences on participation in fall prevention programs. In the discussion (chapter 9) methodological challenges and recommendations for researchers, politicians and practice are presented.

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Part I

Prevention in the hospital setting

2

Barriers and facilitators for screening older adults on fall risk in a hospital setting: perspectives from patients and healthcare professionals

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Abstract

We aimed to gain insight into the barriers and facilitators to fall risk screening of older adults visiting the hospital as experienced by patients and healthcare professionals, and to examine the differences between chronic- and acute-care patients. We invited patients (≥70 years) attending the nephrology and emergency department to participate in the screening. Patients and their healthcare professionals were asked to complete a self-administered questionnaire based on the "Barriers and Facilitators Assessment Instrument". Differences in barriers and facilitators between acute- and chronic-care patients were examined with chi-square tests. A total of 216 patients were screened, and 103 completed the questionnaire. They considered many factors as facilitators, and none as barriers. Acute-care patients were more positive than chronic-care patients about healthcare worker characteristics, such as knowledge and skills. After screening, patients were more open to receiving advice regarding fall prevention. The 36 healthcare professionals considered program characteristics to be facilitators and mainly factors regarding healthcare worker characteristics as barriers to implementation. For patients, the outpatient setting seemed to be a good place to be screened for fall risk. Healthcare professionals also suggested that program characteristics could enhance implementation. However, healthcare professionals' mindsets and the changing of routines are barriers that have to be addressed first.

Introduction

Worldwide, falls and fall-related injuries in older adults are a major public health problem [1]. They can cause a decline in the physical and social functioning of older adults [2] and have a huge economic burden on society [3]. Of all older adults aged 65 years and older, one third experience a fall each year [4–6]. According to the European Public Health Association [5], at least 3.8 million older people visit the emergency department (ED) due to a fall-related injury each year. Of those, 1.4 million need further treatment and are admitted to the hospital. In the Netherlands, among adults 80 years and older, deaths due to a fall have increased significantly in recent years. Between 2000 and 2016, crude mortality rate increased from 78.1 (95%CI, 70.4–85.9) to 334.0 (95%CI, 320.9–347.1) per 100,000 older adults [7]. Based on the aging population, the number of falls, fall-related visits to the ED, and fatal falls are expected to increase in the next few decades [5,8]. The risk of falling increases with age, as does the risk of a more severe injury as a result of the fall. The most common fall-related injuries are bone fractures (54%), of which most are hip fractures (17%), followed by superficial injuries (12%) and mild brain injuries (11%) [9].

To decrease the incidence of falls and related injuries, fall prevention interventions that reduce fall risks are paramount. Many studies indicate that identifying people at risk of falling by screening and multifactorial fall-prevention interventions are (cost-)effective methods in the prevention of falls [10–13]. However, the fact that an intervention has proven to be effective in a study setting does not always ensure its successful implementation in practice [14]. In fact, the rate at which prevention programs are implemented into practice is low [15]. Previous studies have shown that healthcare professionals could play an important role in a successful implementation process [16,17]. Firstly, healthcare professionals could be involved in identifying older adults with a high risk of falling. This is important because people are often not aware of their own fall risk, even when it is high [18,19]. Secondly, they could provide and discuss fall-prevention advice and refer patients to fall-prevention programs.

When implementing fall risk screening and prevention interventions, healthcare professionals might encounter several barriers that could inhibit successful implementation. Most studies on these barriers have been performed within primary care settings, in which providing and discussing advice and referring to fall-prevention programs play important roles. The barriers that are mentioned most often in these settings are a lack of knowledge about existing programs and about other healthcare professionals that could be involved, attributing little importance to fall prevention, and a lack of motivation [20,21]. Little is known about the barriers and facilitators experienced by healthcare professionals when implementing fall-prevention interventions in an in-hospital setting; especially fall-prevention activities targeting outpatients. One study examined barriers to implementing practical guidelines for

preventing falls as experienced by nurses in different departments within a hospital. This study found that a lack of knowledge and motivation, the availability of supportive staff, the access to facilities, the health status of the patients, and staff education were the main barriers to implementing fall-prevention guidelines [22].

For the successful implementation of a fall risk screening program in a clinical setting it is necessary to gain knowledge of the relevant barriers and facilitators not only of healthcare providers, but also of patients. Most studies focusing on implementing fall-prevention exercise interventions report barriers such as denial, underestimation of risk, time commitment, the dislike of group programs, fear of falling, and no exercise history [16,23,24]. However, in the context of fall risk screening within the hospital, most of these barriers are not relevant, and it is unknown which barriers patients experience in this setting. Moreover, there could be differences in perceived barriers and facilitators in older adults who are receiving chronic care and older adults receiving acute care. Older adults with one or more chronic diseases have a significantly higher risk of falling in comparison with older adults without chronic diseases [25], which could potentially influence their ideas about participating in a fall risk screening and prevention program.

The barriers and facilitators mentioned above occur mainly within fall-prevention programs in community settings. Knowledge of barriers and facilitators in an outpatient setting, where potential patients with an elevated fall risk are present, is lacking. Furthermore, since the focus of this screening was on implementation of the screening program within a hospital setting in general, this study focused on a chronically ill population instead of a population in which a high risk is more clear and already expected, such as orthopedic patients. Therefore the aims of this study were (1) to gain insight into the facilitators and barriers to a fall risk screening program for older adults in a clinical setting as perceived by patients (age ≥ 70 years) and healthcare providers, and (2) to examine the differences in the barriers and facilitators between chronic- and acute-care patients.

Materials and methods

Study design and population

This cross-sectional study was part of an implementation study of a fall risk screening program among older adult patients at the Erasmus MC, University Medical Center Rotterdam in the Netherlands. Patients aged 70 years and older who visited the Emergency Department (acute-care patients) or Nephrology outpatient clinic (chronic-care patients) between 1 December 2016 and 31 March 2017 were invited to participate in the fall risk screening program. The study started with a fall risk screening among outpatients. Patients with a low risk of falling received a flyer with their risk status and the advice to visit their

general practitioner (GP) when they had any doubts about their fall risk in the future. For patients with an elevated fall risk, an additional comprehensive fall analysis was performed, and these patients received a personal fall-prevention plan, which was also sent to their GP (in the case of acute-care patients) or to their nephrologist (in the case of chronic-care patients). The physicians were advised to discuss the results of the screening with their patients and to refer patients to a geriatrician for more comprehensive screening when they deemed this necessary. Patients were asked to complete a questionnaire including questions on sociodemographic characteristics and perceived barriers and facilitators of the screening program within the hospital setting (T1). After three months, patients received another questionnaire regarding their perceptions about falls and fall prevention (T2). Barriers and facilitators of the screening program as perceived by the healthcare professionals at the two departments, as well as the GPs of the patients, were also assessed by questionnaire (see figure 1). The study protocol was approved by the ethics committee of Erasmus MC (number 2016-666), and informed consent was obtained from all participants.

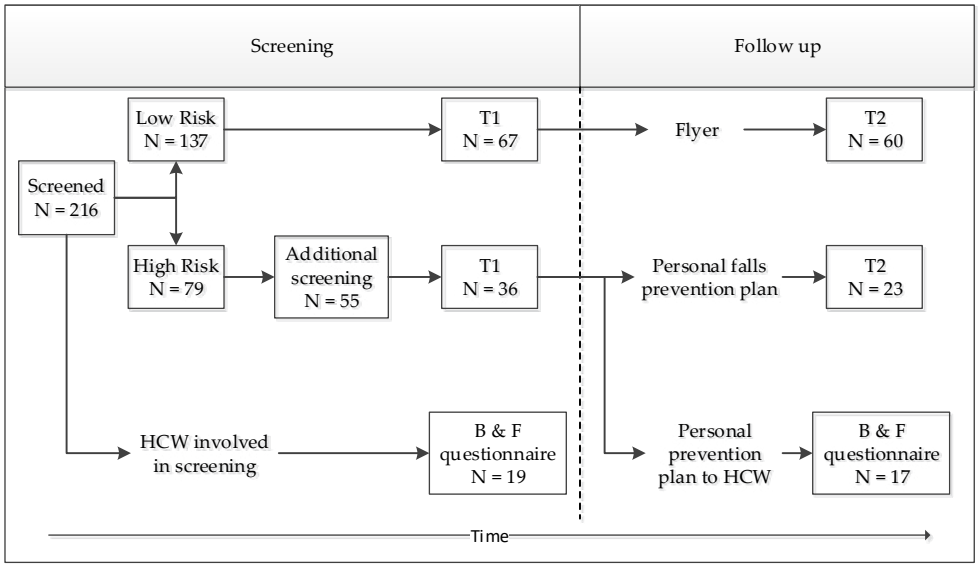

Figure 1. Flowchart of fall risk screening and follow-up. Abbreviations: HCW = healthcare worker; T1 = first questionnaire for patients, which included sociodemographic characteristics and barriers and facilitators; T2 = second questionnaire for patients to assess perceptions about falls and fall prevention; B & F = barriers and facilitators questionnaire for healthcare workers.

Screening program

The fall risk screening program consisted of two steps. The first step was a fall risk test to identify people with an elevated fall risk, which was administered by a nurse of the relevant department. The fall risk test was developed by VeiligheidNL [26] and is primarily used to assess fall risk in community-dwelling older adults (≥65). This simple instrument

was developed based on an earlier validated screening tool by Peeters et al. [27], the "Fall Decision Tree" (in Dutch: "de valbeslisboom"). It was developed based on two factors, namely fall history and balance or mobility problems, and is able to identify people with an elevated risk of falling [28,29]. The instrument consists of three questions: (1) "Did you fall during the past twelve months?", (2) "Do you experience problems with movement and balance?", and (3) "Are you afraid of falling?" When patients answered "yes" to the first question, or to two out of three questions, patients were considered to have an elevated fall risk. For patients identified as having an elevated fall risk, the fall risk screening program involved a second step. A member of the research team or a trained research nurse contacted these patients by telephone to administer a comprehensive fall risk analysis [26]. This additional and more in-depth analysis included questions about different fall risk domains such as mobility and movement and dizziness, which could give an indication of the fall risk factors for each participant. Based on these factors, a personal prevention plan was set up by the research team and was sent to the patient and to the patients' GP. Dependent on the risk factors, the prevention plan consisted of exercise programs that were suggested and tips to help with dizziness, painful joints, memory and concentration, vision, and home adjustments. Although the fall risk test has not been officially validated yet, it is the recommended tool for fall risk screening in older adults [28]. An independent committee reviewed the tool and judged the fall risk test to be well substantiated. Therefore, the fall risk test was included in a national database for effective interventions and tools, the "Centre of Healthy Living" (in Dutch: "Loket Gezond Leven") of the National Institute for Public Health and the Environment (in Dutch: "Rijksinstituut voor Volksgezondheid en Mileu").

Patient characteristics

The following sociodemographic characteristics were collected: gender, age, ethnicity, education level, family status (living alone or together with partner and/or children), housing situation (independent, independent with care, or care institution), housing type (ground floor, house or flat with stairs, house or flat with elevator), and chronic conditions (0 or ≥1). Patients were considered Dutch natives when they themselves and both parents were born in the Netherlands. Education level was categorized as low (less than primary school, primary school, and more than primary school but without another diploma), middle (i.e., technical school, vocational education, general secondary/pre-university education), or high (i.e., college/university). For chronic conditions, patients could answer whether they had chronic conditions other than the one for which they visited the hospital. The question consisted of a list of eight chronic conditions (and an option for another condition that was not part of the list).

Barriers and facilitators

Barriers and facilitators were assessed among patients as well as healthcare providers. The self-administered questionnaires were based on the "Barriers and Facilitators Assessment

Instrument" developed by Peters et al. [30]. All statements, for both patients and healthcare professionals, could be divided into the following four domains: (1) fall-prevention program characteristics, (2) healthcare provider characteristics, (3) patient characteristics, and (4) context characteristics. For healthcare professionals, there was an extra domain assessing attitudes. These statements were self-designed based on constructs of the Theory of Planned Behavior [31].

All patients involved in the screening (acute and chronic care) received a baseline questionnaire. For patients with a low fall risk, this questionnaire was assessed directly after case finding, and for patients with a high risk, after the comprehensive analysis. The questionnaire consisted of 17 statements used to assess barriers and facilitators to the fall risk screening program. After three months, patients received a second questionnaire that consisted of nine statements about falls, fall prevention, and fall risk screening to assess perceptions about fall prevention (see appendix table 1).

All healthcare professionals that were involved in the fall risk screening and follow-up advice (within the hospital and GPs) received a questionnaire that consisted of 34 statements. The questionnaire for the healthcare professionals that performed the fall risk screening focused on barriers and facilitators for the screening itself; they received the questionnaire one month after all patients were screened. The questionnaire for general practitioners and medical specialists involved in the follow-up focused on the barriers and facilitators of implementing the advice as set up by the research team; they received the questionnaire one month after receiving the prevention advice.

The statements could be answered with a five point Likert scale, with answer categories ranging from 1 (totally disagree) to 5 (totally agree). Using the method described by Peters et al. [30], factors were considered barriers if half or more of the respondents (totally) disagreed with the positive statements, or if half or more of the respondents (totally) agreed with negative statements. Factors were considered facilitators if half or more of the respondents (totally) agreed with the positive statements, or if half or more of the respondents (totally) disagreed with negative statements. In addition, negative statements were recoded and a summary index for each dimension was calculated by dividing the sum score of statements in each dimension by the number of statements. The summary index ranged from 1 (very possibly a barrier) to 5 (very possibly a facilitator).

Data analysis

For baseline characteristics, dichotomous data were expressed as number and percentages and continuous variables as mean and standard deviation or median and interquartile range (IQR). The differences in baseline characteristics between acute-care and chronic-care patients were tested with chi-square tests for dichotomous data and the Mann–Whitney U

test for continuous data. Frequencies of (totally) disagree and (totally) agree were calculated for patients' and healthcare professionals' statements, and were expressed as percentages. Chi-square tests were used to test the differences in statements between patients receiving chronic care and patients receiving acute care, and between high- and low-risk patients. In addition, for every dimension, a mean summary index was calculated separately for patients and healthcare professionals. Mann–Whitney U tests were used to compare domains between acute- and chronic-care patients, and between in-hospital healthcare professionals and GPs. In addition, the domains were compared between patients and healthcare professionals. Data were analyzed using SPSS Statistical data software (IBM) version 25 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0 Armonk. NY: IBM Corp.).

Results

Sociodemographic characteristics

In total, 216 patients were screened, of which 116 (53.7%) were chronic-care patients (outpatient clinic) and 100 (46.3%) were acute-care patients (ED). Of those 216, 79 (36.6%) had a high risk of falling. Seventy-seven patients (35.8%) had fallen once or more and 34 (15.8%) had fallen multiple times in the last 12 months. Problems with mobility and balance were experienced by 112 patients (51.9%) and 58 (27.1%) were afraid of falling. The only difference between the departments (chronic vs. acute) was seen in fall history; acute-care patients had fallen more often during the last twelve months (42.2% vs. 28.3%, $p = 0.033$).

Of all patients screened for fall risk, 103 (47.7%) patients completed the barriers and facilitators questionnaire. Of these, 74 were chronic-care patients (response rate: 74%) and 29 were acute-care patients (response rate: 25%). The majority of the respondents was male (73.3%) and the median (IQR) age was 74 (71–77) years. Most patients were born in the Netherlands (89.7%) and lived together with a partner or children without medical help (86.6%). Thirty-five percent of the respondents had a high fall risk. No statistically significant differences between acute-care patients and chronic-care patients were found. More detailed demographic characteristics of these patients are presented in table 1.

Table 1. Social demographics and risk of fall between acute-care and chronic-care patients.

	Total (n = 103)	**Chronic care (n = 74)**	**Acute care (n = 29)**		
	N (%)	N (%)	N (%)	X2	P-value
Age in years, median (IQR)	74.0 (71.0–77.0)	73.0 (71.0–77.0)	75.0 (72.5–78.0)	854.5	0.107
Gender					
Female	27 (26.7)	18 (25.0)	9 (31.0)	0.384	0.535
Male	74 (73.3)	54 (75.0)	20 (69.0)		
Ethnicity					
Dutch	87 (89.7)	62 (88.6)	25 (92.6)	0.341	0.559
Other	10 (10.3)	8 (11.4)	2 (7.4)		
Education level					
Low	48 (51.6)	37 (54.4)	11 (44.0)		
Intermediate	27 (29.0)	18 (26.5)	9 (36.0)	0.963	0.618
High	18 (19.4)	13 (19.1)	5 (20.0)		
Living situation					
Independent	84 (86.6)	62 (89.9)	22 (78.6)		
Independent with care	11 (11.3)	5 (7.2)	6 (21.4)	4.637	0.098
Care institution	2 (2.1)	2 (2.9)	0 (0.0)		
Living together					
Yes	75 (76.5)	52 (74.3)	23 (82.1)	0.687	0.407
No	23 (23.5)	18 (25.7)	5 (17.9)		
Housing type					
Ground floor	10 (10.3)	8 (11.6)	2 (7.1)		
House or flat with stairs	46 (47.4)	34 (49.3)	12 (42.9)	1.113	0.573
House or flat with elevator	41 (42.3)	27 (39.1)	14 (50.0)		
Chronic conditions					
At least one	81 (81.8)	55 (77.5)	26 (92.9)	3.198	0.074
None	18 (18.2)	16 (22.5)	2 (7.1)		
Elevated fall risk					
Yes	36 (35.0)	27 (36.5)	9 (31.0)	0.272	0.602
No	67 (65.0)	47 (63.5)	20 (69.0)		
Fall risk questions (Yes)					
Fallen in the past year	36 (35.0)	24 (32.4)	12 (41.4)	0.734	0.392
Fallen multiple times	16 (15.5)	14 (18.9)	2 (6.9)	2.295	0.13
Problems moving	48 (46.6)	37 (50.0)	11 (37.9)	1.22	0.269
Afraid of falling	20 (19.8)	16 (22.2)	4 (13.8)	0.925	0.336

A *p*-value of <0.05 was considered statistically significant.

Barriers and facilitators of patients

The majority of the patients (both in chronic care and acute care) considered the following factors to be positive factors for implementation of the fall risk screening program: attractiveness of the program, financial status, ethnicity, and time investments. More precisely, the majority of the patients had no negative expectations of fall risk screening

(attractiveness) (59.4%), expected to benefit from the screening (attractiveness) (59.8%), were not afraid the screening would cost them money (financial status) (58.0%), had enough time to be screened (time investment) (75.2%), and thought the program was concordant with their culture and/or values (ethnicity) (76.0%). Patients receiving acute care reported more positive factors than patients receiving chronic care. They also considered the skills and knowledge of healthcare workers, the specific healthcare workers involved (specificity/ flexibility) the place of screening (facilities), the ideas people in their surroundings had about participating in fall risk screening (group norms), and the need to be screened for fall risk (motivation to change) as positive factors. No statistical differences between departments were seen in percentages that (fully) agreed or (fully) disagreed with statements. The patients did not indicate barriers to the fall-prevention screening program. More information about the statements can be found in table 2.

Three months after screening for fall risk at the departments, most patients (75.9%) indicated that they were more open to receiving advice on preventing falls. Most patients also indicated that they had a more positive attitude towards fall risk screening and fall prevention (69.9%), and most patients were more inclined to take action to prevent falling (63.9%). No differences were seen between patients who received acute or chronic care. Patients who were at high risk for falls and thus received a personal fall-prevention plan more often reported that they had more knowledge to support prevention of a fall (73.9% vs. 51.7%, *p*-value: 0.044)

Table 2. Barriers and facilitators of chronic-care and acute-care patients considered in hospital fall risk screening.

		All patients (n = 103)		Chronic care (n = 74)		Acute care (n = 29)		Chi-Square
Negative statements	Domain	agree %	disagree %	agree %	disagree %	agree %	disagree %	*p*-value
Skills: HCWs do not have the right skills for FRS.	HCW	16.5	44.7	18.9	39.2	10.3	**58.6**	0.190
Knowledge: HCWs do not have the right knowledge for FRS.	HCW	17.6	41.2	21.9	35.6	6.9	**55.2**	0.096
Health status: I do not appreciate it when people interfere with my health when I did not ask for it.	Patient	35.3	46.1	38.4	45.2	27.6	48.3	0.500
Ethnicity: Early detection of disease is not concordant with my culture/values.	Patient	11.0	**76.0**	8.3	**79.2**	17.9	**67.9**	0.359
Financial status: I am afraid FRS will cost me money.	Patient	19.0	**58.0**	22.5	**57.7**	10.3	**58.6**	0.252
Compatibility: I think FRS is executed at an inconvenient time.	Program	16.0	44.0	15.5	45.1	17.2	41.4	0.941
Attractiveness: I have negative expectations of FRS.	Program	11.9	**59.4**	12.5	**59.7**	10.3	**58.6**	0.922
Specificity, flexibility: I do not believe that FRS can detect fall risk at an early stage and prevent deterioration.	Program	33.3	32.4	34.2	31.5	31.0	34.5	0.941
Didactive benefit: Since I have been screened for fall risk, I am not going to prevent falling in a more active manner.	Program	28.2	30.1	25.7	29.7	34.5	31.0	0.578
Positive statements	Domain	agree %	disagree %	agree %	disagree %	agree %	disagree %	p-value
Specificity, flexibility: FRS belongs to the duties of nephrology/ED HCWs.	Program	48.0	16.7	42.5	19.2	**62.1**	10.3	0.191
Attractiveness: I expect to benefit from FRS.	Program	**59.8**	10.8	**54.8**	11.0	**72.4**	10.3	0.210
Time investment: I have enough time to be screened for fall risk.	Context	**75.2**	13.9	**75.3**	15.1	**75.0**	10.7	0.709
Supportive staff: There are enough staff at the nephrology/ED department to screen for fall risk.	Context	35.4	18.2	32.9	17.1	41.4	20.7	0.547
Facilities: The nephrology/ED department is an appropriate place for FRS.	Context	47.5	25.3	43.1	27.8	**59.3**	18.5	0.350
Group norms, socialization: People in my surroundings that are important to me would participate in FRS.	Context	40.6	15.8	36.1	13.9	**51.7**	20.7	0.121
Motivation to change: I feel a need to be screened for fall risk.	Patient	43.6	32.7	40.3	34.7	**51.7**	27.6	0.575
Motivation to change: Since I have been screened for fall risk, I am more aware of my risks of falling.	Patient	37.9	26.2	35.1	27.0	44.8	24.1	0.653

Bold = Facilitator for implementing the fall risk screening program. *Italic* = Indicates the subject of the statement. Domains are: HCW = healthcare worker characteristics; Patient = patient characteristics; Program = fall-prevention program characteristics; Context = context characteristics. Abbreviations used within statements: HCW = healthcare worker; FRS = fall risk screening; ED = emergency department. "Agree" means "agree" and "fully agree". "Disagree" means "disagree" and "fully disagree".

Barriers and facilitators of healthcare professionals

Of the healthcare professionals that performed the screening, nineteen completed the questionnaire, including fourteen (73.7%) emergency department professionals (managers, nurses, students, and administrative staff) and five (26.3%) healthcare professionals of the nephrology department (healthcare assistants). The facilitators mentioned most frequently were the appropriateness (73.7%), the importance (63.2%), and the attractiveness (63.2%) of the program. However, besides facilitators, healthcare professionals also reported barriers. For healthcare professionals who performed the screening, the most frequently mentioned barriers were patients' cooperation in applying the program (motivation to change) (84.2%), resistance to working according to protocols (attitude, role perception) (78.9%), and reading and remembering the program (practice involvement) (78.9%). Of the 34 statements, healthcare professionals who performed the screening considered four factors to be facilitators and twelve to be barriers.

Of the healthcare professionals who were involved in follow-up consultation and advice (GPs and medical specialists), seventeen completed the questionnaire. The most mentioned facilitators were the fact that it is not difficult to give preventive care if there are not enough supportive staff (supportive staff) (76.5%), and that it's not difficult to give preventive care when not being involved in the setup (setup involvement) (64.7%). Healthcare professionals who were involved in the follow-up reported barriers only within the healthcare worker domain. The barriers mentioned were changing routines in working style (lifestyle, working) (76.5%), resistance to working according to protocols (attitude, role perception) (52.9%), and reading and remembering the program (practice involvement) (52.9%). Of the total of 34 statements, healthcare professionals who were involved in the follow-up considered six factors to be facilitators and three to be barriers. More information about the statements made by healthcare professionals can be found in table 3.

Table 3. Barriers and facilitators of healthcare providers to implementing the fall screening program in older adults.

		Screening (n = 19)		Follow-up advice (n = 17)	
Negative statements	Domain	agree %	disagree %	agree %	disagree %
Compatibility: The fall-prevention program does not fit into my ways of working at my practice.	Program	36.8	21.1	11.8	5.9
Time investment: Working to the fall-prevention program is too time consuming.	Program	36.8	36.8	11.8	35.3
Attitude, role perception: I have a general resistance to working according protocols.	HCW	**78.9**	5.3	**52.9**	0.0
Doubts about innovation: I think parts of the fall-prevention program are incorrect.	HCW	47.4	5.3	47.1	0.0
Lifestyle, working style: I have problems changing my old routines.	HCW	**73.7**	15.8	**76.5**	0.0
Education: It is difficult to give preventive care because I am not trained in giving preventive care.	HCW	42.1	21.1	17.6	47.1
Practice involvement: I did not thoroughly read nor remember the fall-prevention program.	HCW	**78.9**	10.5	**52.9**	17.6
Setup involvement: It is difficult to give preventive care because I have not been involved in setting up the preventive care.	HCW	31.6	47.4	5.9	**64.7**
Knowledge, motivation: I wish to know more about this fall-prevention program before I decide to apply it.	HCW	36.8	21.1	29.4	**52.9**
Ethnicity: It is difficult to give this preventive care to patients with a different cultural background.	Patient	31.6	**57.9**	11.8	41.2
Financial situation, economic status: It is difficult to give this preventive care to patients with a low socioeconomic status.	Patient	**52.6**	26.3	17.6	35.3
Number of patient contacts: It is difficult to give this preventive care to patients who rarely visit the clinic.	Patient	**52.6**	26.3	5.9	**58.8**
Health status: It is difficult to give this preventive care to patients who seem healthy.	Patient	47.4	26.3	5.9	**58.8**
Motivation to change: Patients do not cooperate in applying this fall-prevention program.	Patient	**84.2**	5.3	29.4	17.6
Group norms, socialization: Colleagues from my discipline do not cooperate in applying the fall-prevention program.	Context	36.8	15.8	47.1	11.8
Group norms, socialization: Colleagues from other disciplines do not cooperate in applying the fall-prevention program.	Context	21.1	21.1	17.6	5.9
Group norms, socialization: Managers/directors do not cooperate in applying the fall-prevention program.	Context	**57.9**	5.3	35.3	0.0
Reimbursement, insurance system: Working according to this fall-prevention program requires financial compensation.	Context	15.8	21.1	11.8	5.9
Opening hours of practice: It is difficult to give preventive care because the timing of the preventative care is awkward.	Context	36.8	26.3	11.8	41.2
Supportive staff: It is difficult to give preventive care if there are not enough supportive staff.	Context	26.3	42.1	11.8	**76.5**
Facilities: It is difficult to give preventive care if instruments needed are not available.	Context	**63.2**	15.8	5.9	41.2
Practice building: It is difficult to give preventive care if physical space is lacking (e.g., rooms).	Context	**57.9**	21.1	23.5	47.1
Attitude: This fall-prevention program is useless.	TPB	**73.7**	5.3	29.4	11.8
Attitude: This fall-prevention program is unwise.	TPB	**68.4**	0.0	35.3	0.0

Positive statements	Domain	agree %	disagree %	agree %	disagree %
Specificity, flexibility: This fall-prevention program leaves enough room for me to make my own conclusions.	Program	47.4	5.3	41.2	11.8
Specificity, flexibility: This fall-prevention program leaves enough room to weigh the wishes of the patient.	Program	47.4	5.3	47.1	5.9
Didactive benefit: This fall-prevention program is a good starting point for my self-study.	Program	15.8	21.1	47.1	29.4
Attractiveness: The layout of this fall-prevention program makes it handy for use.	Program	**63.2**	15.8	47.1	11.8
Attitude: This fall-prevention program is appropriate.	TPB	**73.7**	0.0	29.4	5.9
Attitude: This fall-prevention program important.	TPB	**63.2**	5.3	29.4	0.0
Subjective norm: Colleagues that I identify with would apply this fall-prevention program.	TPB	31.6	10.5	0.0	17.6
Perceived behavioral control: I believe that when I apply this fall-prevention program I can prevent falls.	TPB	21.1	15.8	**52.9**	5.9
Intention: I am willing to structurally apply this fall-prevention program to all my future patients aged 70 years and older.	TPB	36.8	21.1	5.9	23.5
Behavior: I have applied this fall-prevention program to patients in the past.	TPB	31.6	**63.2**	41.2	41.2

Bold is barrier or facilitator. *Italic* = Indicates the subject of the statement. Domains are: HCW = healthcare worker characteristics; Patient = patient characteristics; Program = fall-prevention program characteristics; Context = context characteristics; TPB = Theory of Planned Behavior.

Similarities and differences in domains between patients and healthcare professionals

All statements were summarized into the following domains: program characteristics, healthcare worker characteristics, patient characteristics, and context characteristics. For healthcare professionals, an extra domain regarding statements derived from the Theory of Planned Behavior was added. Patients scored the context characteristics as most probably being a facilitator (median: 3.5, IQR: 3–3.75), while healthcare professionals scored the program characteristics as most probably being a facilitator (median: 3.17, IQR: 3–3.5). Healthcare professionals and patients considered the healthcare worker characteristics to most probably be a barrier. However, this was scored more highly as a barrier by healthcare professionals (median: 2.79, IQR: 2.29–2.86) than by patients (median: 3.33, IQR: 3–4) (*p*-value: <0.001). Other differences between patients and healthcare professionals were seen in context (*p*-value: <0.001) and patient characteristics (*p*-value: <0.001). These domains were scored more highly as possible facilitators for implementing fall risk screening among patients than among healthcare professionals (figure 2a). Within patients, acute-care patients reported higher scores in the healthcare worker domain than chronic-care patients (*p*-value: 0.016) (figure 2b). For healthcare professionals, in the domains healthcare worker characteristics (*p*-value: 0.009), patient characteristics, (*p*-value: 0.001), and context characteristics (*p*-value: >0.001), higher scores were reported by healthcare professionals who were involved in the follow-up than by the healthcare professionals who performed the screening (figure 2c).

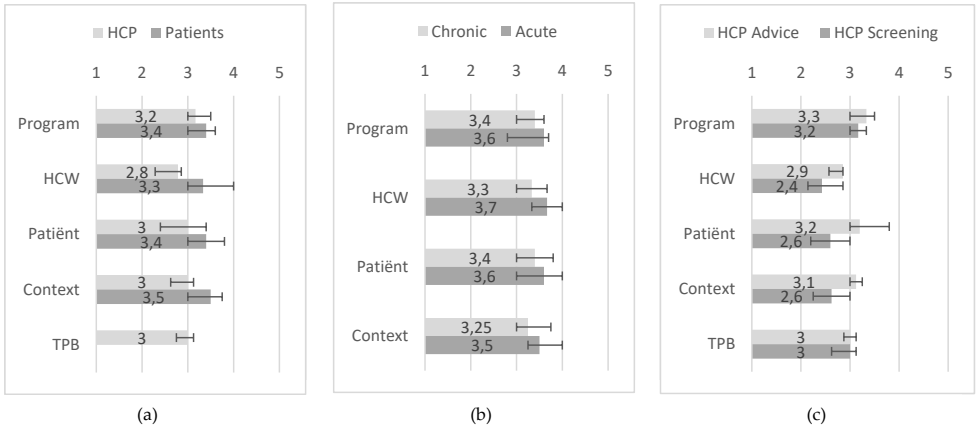

Figure 2. Median and IQR of domains within patients and health care professionals: (**a**) Comparison of healthcare professionals and patients; (**b**) Comparison of chronic and acute care patients; (**c**) Comparison of healthcare professionals that were involved in the advice and that performed the screening. HCP=healthcare professional, GP=general practitioner, HCW=healthcare worker characteristic, TPB=Theory of planned behaviour characteristic.

Discussion

The results of this study showed that most patients see no barriers for fall risk screening within an outpatient setting. Overall, they perceived multiple facilitators for implementing fall risk screening, and no barriers. Most patients perceived the screening to be concordant with their ethnic values and as a small time investment. Older adults presenting at the ED identified more facilitators compared to patients with a chronic health problem. Healthcare professionals identified factors that would be helpful in implementing fall risk screening, including supportive staff and the attractiveness of the program. However, they were less positive than the patients and identified multiple factors as barriers, including their working style and their role perception. In particular, healthcare professionals who performed the screening identified many barriers.

Patients reported no barriers regarding patient characteristics, healthcare worker characteristics, context characteristics, or program characteristics for outpatient fall risk screening. However, there were some factors we did not look into in the current study that could be possible barriers. Factors that were not investigated in our study included transport problems and personal factors, and concerns including the risk of injuries, feeling too healthy, having impaired mobility, and trying something new, which were all barriers identified in other studies. Nevertheless, other studies have also mentioned barriers that were included in the current study, namely time investment and costs [16,32,33]. A possible explanation for the fact that the participants in the present study did not consider those practical factors to be barriers for participating in the outpatient fall risk screening is that the current study consisted only of screening and not of an intervention involving physical activity or additional appointments. In these interventions, costs and investment of time play a bigger role compared to a free screening during an appointment in which they had already invested time. Another barrier found in other studies is low motivation, due to a lack of perceived personal relevance. This was not observed in the current study, possible due to older adults' health status during screening. Since all older adults were screened during their visit to a hospital, it can be assumed that they were experiencing health problems. Screening in an outpatient setting seems a great opportunity to make older adults more aware of their fall risk, as most patients in the present study indicated that they were more open to receiving advice on how to prevent falls after they were screened. The screening could be the first step in the prevention of falls, since older adults in our study were not only more open to advice, but also more inclined to take action to prevent falling.

Besides the time investment and costs, the attractiveness of the program and the concordance with cultural values (ethnicity) were also identified as facilitators in the current study. Patients reported expecting to benefit enough from the fall risk screening (attractiveness), which possibly made up for the small time and cost investments they had to

make. In previous research, less focus has been placed on facilitators compared to barriers. In studies where facilitators have been reported, the interventions involved adjustments in the lives of older adults. Facilitators for these types of interventions include the perceived benefits, involvement of a healthcare professional, and social support [24]. As with barriers, we observed that this type of intervention involves different facilitators than the fall risk screening within an outpatient setting that we performed.

With respect to the second aim of this study, it was found that even though there were no significant differences within the statements, the acute-care patients considered more factors to be facilitators for participating in the screening program than chronic-care patients. This was mainly reflected in the healthcare worker domain by the statements "healthcare professionals do not have the right skills for fall risk screening" and "healthcare professionals do not have the right knowledge for fall risk screening". On one hand, this difference between acute- and chronic-care patients might be noteworthy since chronic-care patients, due to their more regular visits, may feel a stronger bond with their physician. It could be argued that for that reason they have more trust in the actions of their physician. On the other hand, they may not be familiar with receiving care different from their usual care by their physician, which is not the case for acute-care patients. In addition, screening is more common at the ED than at other departments [33]. This was also reflected in the statement: "Fall risk screening belongs to the duties of nephrology/ED healthcare workers", which was scored more positively by acute-care patients. In addition to the factor of familiarity, patients' answers may have been affected by healthcare worker characteristics such as age, type of healthcare worker, experience, etc. However, since we did not collect these characteristics of healthcare providers for specific patients, we were not able to look into this possibility. Nevertheless, the fact that a lower trust in healthcare professionals with screening at the nephrology department did not lead to barriers among patients for implementing fall risk screening is a good starting point for further implementation in other departments.

Older adult patients perceived the outpatient clinic to be an appropriate place to be screened for fall risk. Healthcare professionals, however, were less positive. Although they considered several factors to be facilitators for implementing a fall risk screening program, they also perceived several factors that could inhibit the implementation of a fall risk screening program in an outpatient setting. Based on the different domains of the questionnaire, the program characteristics domain was reported most positively among healthcare providers. This implies that the setup of the program could be used in further implementation of outpatient fall risk screening interventions. In addition, healthcare providers who were involved in the screening stated that the program is handy for use, appropriate, and important. However, healthcare providers also stated that the program was useless and unwise, which indicated exceptionally low opinions of the program. Further

research into the manner in which these factors influence healthcare providers' motivations in the implementation of fall-prevention programs is necessary to fully understand this seeming discrepancy. A reason for the negative results might be the effort it involves for healthcare providers, which was also seen in overall barriers among healthcare providers. In particular, changing routines, resistance to working with protocols, and reading and remembering the fall-prevention program were considered impediments to implementing the screening program into practice. These barriers have not been directly observed in other studies, but they may be associated with a lack of motivation, which is a known barrier for implementing fall-prevention interventions [22]. Furthermore, other studies have reported financial situation, time investment, and patient health status as barriers [16,34]. A lack of knowledge is often found to be a barrier to implementation of fall risk interventions among healthcare professionals [22,34,35], but the findings of the current study did not confirm that. A possible explanation could be that the actual knowledge of healthcare professionals was not measured. The only two statements regarding knowledge did not involve general knowledge about fall prevention, but rather the wish to know more about the program and their own knowledge of preventive care. Another explanation could be that all healthcare professionals involved in the medical care of the older adults were included (e.g., nephrologist, emergency department specialist, nurse specialists), and the study was executed in a university medical center at which knowledge of healthcare professionals on evidence-based practice may be deemed to be sufficient [22].

In addition to the existing literature, this study helps to illustrate why cost-effective fall-prevention programs, such as fall risk screening, are not always successfully implemented. We knew that barriers were experienced with fall-prevention programs in community settings, and that these barriers were present among older adults as well as healthcare professionals. Unlike in prevention in community settings, this study showed that barriers within an outpatient setting are mainly reported by healthcare professionals and less among older adults. The barriers experienced were also different compared to the implementation of fall-prevention programs and focused especially on the working style and attitude of professionals instead of their knowledge. However, it is not clear how healthcare professionals can overcome these specific barriers and how to increase intrinsic motivation among those professionals for successful implementation of fall risk screening. Studies using qualitative methods should look into this further, to find ways to overcome these barriers. Furthermore, it was not clear whether the characteristics of healthcare providers affected the responses of patients. Further research into the characteristics of healthcare providers could provide valuable insights related to the implementation of fall risk screening.

For future implementation of fall risk screening programs in outpatient settings, it is important to pay special attention to the barriers that were reported by the healthcare professionals. It could also be beneficial to enhance the facilitators that were described

in the current study. Besides these facilitators, a perception of the usefulness of the intervention, satisfaction with medical care for fall and increased consultation time are associated with a better uptake of fall-prevention interventions [34]. However, despite the facilitators we found among healthcare professionals and patients, some facilitators had only a small majority, and this alone is not sufficient for successful implementation. Therefore, besides taking into account the barriers and facilitators from the current study, we recommend using existing implementation tools for the implementation of outpatient fall risk screening in daily practice. These implementation tools can help with informing and motivating healthcare professionals and increasing adherence to the screening guidelines [36]. Based on our experience with implementing the screening program, tools should focus on educating, informing, and motivating healthcare providers. Informing and educating could focus on changing outcome beliefs, which were low, especially among healthcare professionals who were involved in the screening. Only 21.1% agreed

with the statement: "I believe that when I apply this fall-prevention program I can prevent falls". Addressing issues about outcome beliefs and beliefs to make a difference are important for creating motivation and commitment [37]. In this case, especially a tool based on a capacity-building strategy, which targets motivation and capability to engage implementation processes [38], would be helpful. Capacity-building strategies can include internet-based instructions, training and workshops to increase knowledge, technical assistance, education using self-directed learning, communities of practice, and multi-strategy interventions [39]. Despite the fact that capacity-building strategies are usually applicable across multiple settings [38], further implementation research should focus on tools that can be used to overcome the specific barriers among healthcare providers for fall risk screening.

Strengths and limitations

This study had several strengths and limitations. It was performed in an outpatient setting, while previous research has looked more at barriers and facilitators in community settings. In addition, in the current study, we were able to find different barriers and facilitators for healthcare professionals that were involved in the same screening program at different time points. Another strength was that within this outpatient settings, we looked at both an acute care setting and a chronic care setting. Since these patients were in different conditions and had different reasons to visit the hospital, this could have led to different barriers and facilitators. At the same time, this study looked at patients' as well as healthcare professionals' barriers and facilitators.

When interpreting the results of the present study, it should be taken into account that only patients who participated in the screening program received a questionnaire to assess the barriers and facilitators they encountered for participating in the screening program.

Older adults who declined the screening during their visit at the hospital might have had other replies, which could have resulted in more barriers being reported by patients. In addition, there was a risk of response (social desirability) bias, because older adults completed the questionnaire during their visit to the hospital. In addition to patients who declined screening, despite the 100 patients screened at the ED department, ultimately only 29 participated in the study. This could have influenced the results in the same way as mentioned above. Furthermore, we might have lost to follow-up the older adults who were less positive about fall risk screening and fall prevention in general. Therefore, we do have to be careful with interpreting the results of this acute-care group, but also in the comparison with chronic-care patients; acute-care patients were slightly more positive towards screening. In addition, we did not assess the characteristics of healthcare providers, which made it impossible to determine whether the characteristics of healthcare providers affected patients' answers regarding the healthcare worker domain. Lastly, the questionnaire used was based on the "Barriers and Facilitators Assessment Instrument" developed by Peters et al., which is a validated questionnaire. However, for the current study, questions were removed and the Theory of Planned Behavior domain was added. This questionnaire has not been used and validated in previous research, and more research is necessary to validate the shortened questionnaire with the new domain for healthcare professionals, as well as the questionnaire used for patients.

Conclusions

It can be concluded that for older adults, the outpatient clinic and ED seems to be a good place to screen for fall risk. Most patients were positive about the non-invasive screening and willing to participate, which resulted in patients being more open to receiving fall-prevention advice. From that point of view, fall risk screening in these outpatient settings could be the first step to preventing falls among older adults by improving their fall risk awareness during their hospital visits. Healthcare professionals also reported factors that could enhance the implementation of outpatient fall risk screening. In particular, program characteristics were experienced as possible facilitators for implementation. However, implementation is complex and healthcare professionals reported barriers as well. The barriers that need to be addressed were especially related to the healthcare worker characteristics domain, involving a change of the mindset and routines of healthcare professionals. To achieve this, healthcare professionals need to be informed and motived to enhance intrinsic motivation. Existing implementation tools can also play an important role in this and should be used for successful implementation in daily practice of fall risk screening in outpatient settings.

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Appendix

Table 1. Questionnaire for high-risk patients to assess perceptions about falls, fall risk, and fall prevention three months after screening in the hospital.

Statements	Totally Disagree	Disagree	Neutral	Agree	Totally Agree
1. I am more open to receiving advice on how to prevent falling.	□	□	□	□	□
2. I have a more positive attitude toward fall risk screening and fall prevention.	□	□	□	□	□
3. I am more inclined to take action to prevent falling.	□	□	□	□	□
4. I can count on more understanding and/or help from those around me to prevent falling.	□	□	□	□	□
5. I have more knowledge of actions I can take to prevent a fall.	□	□	□	□	□
6. I feel I am more self-sufficient.	□	□	□	□	□
7. I am more aware of the risk of falling.	□	□	□	□	□
8. I feel more capable of preventing a fall.	□	□	□	□	□
9. I did things to prevent falling.	□	□	□	□	□

3

Can fall risk screening and fall prevention advice in hospital settings motivate older adult patients to take action to reduce fall risk?

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Abstract

Objective: We investigated whether an in-hospital intervention consisting of fall risk screening and tailored advice could prompt patients to take preventive action.

Method: Patients (≥70) attending the emergency department and nephrology outpatient clinic in a Dutch hospital were screened. Patients at high risk received tailored advice based on their individual risk factors. Three months after screening, preventive steps taken by patients were surveyed.

Results: Two hundred sixteen patients were screened. Of the 83 patients completing a 3-month follow-up, 51.8% took action; among patients who received tailored advice (*n* = 20), 70% took action. Patients most often adhered to advice on improving muscle strength and undergoing vision checkups (20%). Tailored advice and a reported low quality of life were associated with consulting a health care provider.

Discussion: Patients at risk in these settings are inclined to take action after screening. However, they do not always adhere to the tailored prevention advice.

Introduction

Falls and related injuries are major public health problems [1]. For older adults, falls often lead to depleted daily life and social activities due to related injury and increased fear of falling [2,3]. Thirty percent of adults aged ≥65 years experience a fall every year, and this rate increases with age [4,5]. After a fall, 66% of older adults are injured, 20% to 30% visit a hospital, and 11% are admitted [4,6]. Despite the growing attention to fall prevention and available fall prevention programs [7-10], the number of fall-related emergency department (ED) visits and hospital admissions due to fall-related injuries keep rising [11-15].

One challenge in prevention is the low adherence to related interventions among older adults [16]. Barriers including fear of falling [17], frailty [18], too time consuming [19], no exercise history [17], and transportation problems [18,19] affect uptake and adherence to exercise programs. Furthermore, more general barriers such as a lack of awareness of existing programs [17,18,20], patients' perceptions of programs' effectiveness [17,20], denial of risk [17], and underestimation of risk [17,20] impede fall prevention implementation.

Self-perceived risk and awareness about risk status can positively affect implementation [20]. Many older adults who have not yet experienced a fall are unaware of their increased risk of falling [21,22]. Therefore, identifying older adults with high fall risk is essential to create awareness among this population [23]. Along with identifying risk, recognition of personal risk factors is important to offering tailored fall prevention advice. Advice tailored to the patient's specific problems and needs increases its effectiveness [24,25] and adherence to fall prevention [26].

Primary care providers such as physiotherapists and general practitioners (GPs) frequently provide care for older adults and, therefore, have great potential to detect risk and risk factors [18,27]. Apart from primary care providers, secondary care providers in hospital settings provide an opportunity to detect older adults with high fall risk [23,28,29]. However, contrary to international guidelines [23,30-32] in-hospital fall prevention is not yet standardized in the Netherlands. Furthermore, studies on the implementation of such guidelines in outpatient settings are lacking. At present, older adults are more frequently screened only at EDs for fall risk [23]. Meanwhile, patients with chronic diseases not directly resulting from a fall could also be at a potentially high risk of falling [33]. Such patients tend to have more contact within the hospital than patients visiting the ED and, therefore, build a stronger relationship with their specialist, affecting the uptake of and adherence to advice [34].

Because guidelines are not well implemented, the positive effect of self-perceived risk, awareness, and tailored advice in hospital settings remains inadequately studied. To map

risk and risk factors of this specific cohort and provide patients with tailored advice, this study sought (a) to explore fall risk and risk factors of patients in two hospital settings (i.e., ED and outpatient clinic). We investigated (b) whether a hospital-based fall risk assessment followed by tailored prevention advice can prompt patients to take action to reduce their fall risk and (c) which patient characteristics are associated with taking action after screening. We performed this screening at an ED and a nephrology outpatient clinic (NOC) of a university teaching hospital to assess both patients in general and patients with chronic diseases.

Method

Study design and population

This observational cohort study was performed from December 2016 to June 2017. Interested patients were recruited in the waiting room within the first 3 months. Following existing Dutch guidelines on screening older adults in a hospital, patients aged ≥70 years who visited the NOC or ED of the Erasmus Medical Center in Rotterdam, the Netherlands, were invited for a fall risk screening. The null hypothesis was to find no relationship between guideline adherence and determinants of guideline adherence. For the calculation of the sample size, we set the threshold probability for rejecting the null hypothesis (α two-tailed) at .05. To prove guideline adherence, it was required that 38 patients at high risk of falls participate. Considering an average high fall risk of 37.5%, nonresponse (estimated at 65%), and dropouts in fall prevention (estimated at 15%), at least 183 patients had to be included. Patients were screened in these departments because of the larger number of frail older patients visiting and the relevant comorbidity pertaining to falls. Exclusion criteria were (a) not understanding the Dutch language and (b) incapacitation. Patients screened at the NOC were informed about the study by one of the researchers; those interested provided informed consent immediately after screening. Patients screened at the ED received information about the study and provided informed consent by mail. In addition to data collection in the departments, data were also gathered by a survey 2 weeks and 3 months after screening. The medical ethics committee of Erasmus MC, University Medical Center Rotterdam, provided ethical approval (number 2016-666).

The study included intervention and data collection by survey. In the intervention, patients were screened for fall risk at two hospital departments. Patients with low fall risk received a flyer clarifying that, at the moment of screening, they did not have high fall risk. Patients with high fall risk were contacted for a comprehensive fall risk analysis to identify the risk factors present. They received personal fall prevention advice based on their risk factors. For data collection by survey, the patients screened received two surveys regarding patient characteristics and the actions patients took to prevent falling.

Intervention

Fall risk screening

In both departments, the Dutch fall risk test was used to screen older adults for fall risk. It is based on three factors mentioned in the existing literature, which are most frequently associated with recurrent falls, namely, (a) a history of falls and (b) problems with movement and balance [35]. The fall risk test comprises three questions: (a) Did you fall during the past 12 months? (b) Do you experience problems with movement and balance? and (c) Are you afraid of falling? The first question can be answered with no, yes, once, or yes, multiple times, and the other questions with no or yes. The fall risk test labeled a patient answering "yes" to the first question or to two of the three questions as high fall risk [36]. Within the Netherlands, this test is recommended to screen community-dwelling older adults [37].

Fall risk analysis to inform individual prevention advice

For patients with high fall risk, screening also involved a comprehensive fall risk analysis by telephone. This analysis was performed within 2 weeks after the initial screening by a trained research nurse and aimed to identify personal risk factors associated with high fall risk to compare risk factors between departments and target further preventive activities. The analysis comprised questions on 12 known fall risk domains that were determined based on existing questionnaires [38,39] and expert opinion. The risk domains used were prescription drug use (cardiovascular medication and psychotropic medication), poor mobility and balance, fall history, painful feet, poor vision, fall hazard in one's own living environment, painful joints, fear of falling, osteoporosis, dizziness, challenges performing daily living activities, and poor memory and concentration. An overview of the risk domains and when a domain was considered a risk factor are in the appendix (table 1).

Tailored prevention advice

After screening, patients with low fall risk received a flyer informing them they had low fall risk and could consult a GP for further questions. Patients undergoing the comprehensive analysis received tailored prevention advice by post based on risk factors. For the medication, fall history, painful feet, osteoporosis, and challenges performing daily living activities, patients were advised to meet a GP. The domains poor mobility and balance, poor vision, fall hazards in one's own living environment, painful joints, fear of falling, dizziness, and poor memory and concentration each carried specific advice. For example, when "mobility and balance" was a risk factor, patients received advice on two multifactorial fall prevention programs located near their homes. An overview of risk domains, definitions of risk factors, advice, and type of action linked to the advice are in the appendix (table 1).

Data collection

Follow-up data by survey were collected at two time points: 2 weeks post–initial screening at the ED and NOC and at 3 months of follow-up. Two weeks after initial screening, all patients

received a survey by post or email. For patients with high fall risk, this survey was sent after a comprehensive analysis. This survey included sociodemographic questions on age, sex, ethnicity, whether living independently or with partner or children, and education level. Patients were considered Dutch when born in the Netherlands, and immigrant if the patient or one parent was born elsewhere. Education level was categorized as low (below primary school, primary school, or little more than primary school), intermediate (i.e., technical school, vocational education, general secondary/pre-university education), and high (i.e., college/university). They were asked about chronic conditions, and eight options were listed to which they answered yes or no. An open question was included to note other chronic conditions. The total chronic conditions were thus calculated. Health-related quality of life was assessed by the five-dimensional EuroQol instrument (EQ-5D-5L + cognition) [40], in which a utility score was calculated using the Dutch tariff, with scores ranging from 0 (death) to 1 (full health) [41]. In addition, patients could rate their own health on the Visual Analog Scale (VAS [0–100]) for quality of life.

At 3 months follow-up, a second questionnaire was sent to assess the preventive actions undertaken, asking the following: (1) Did you undertake any fall prevention action without help of a health care professional? (2) Did you consult a GP about fall prevention? and (3) Did you consult a medical specialist regarding fall prevention? Patients could indicate whether they had undertaken any of these fall preventive actions with the following answers: looked up or received information, performed mobility training to improve muscle strength and/or endurance, performed mobility training to improve skills, had eyes tested, made changes to shoes, made adjustments in and around the house, received lifestyle advice, and stopped or changed medication. To determine adherence, these actions were compared between departments and with the postscreening advice.

Statistical analyses

Baseline and follow-up characteristics were expressed as mean and standard deviation for continuous variables and as numbers and percentages for dichotomous variables. Differences in baseline characteristics and preventive actions between participants with low and high risk were compared using a Mann–Whitney U test for continuous variables and a chi-square test for dichotomous variables. The chi-square was also used for comparison between departments on fall risk factors and the actions patients undertook. Adherence to advice was expressed as percentages. To investigate which characteristics, regardless of risk, were associated with taking action, logistic regression analyses were used. A univariate model was used to determine the relationship between characteristics and undertaking action. We could not collect a clear set of characteristics from the literature, which could be expected to be associated with taking action. Therefore, we included as independent variables all baseline characteristics and whether patients received tailored advice, after which all characteristics with a significance level of <.20 were selected for a multivariable

model. Variables were included in the multivariate model using the Enter method. Taking action, taking action with a health care worker, and taking action independently were used as dependent variables; the variable "help from a health care worker" merged help from a GP and a specialist. For assessing model goodness-of-fit, Nagelkerke R^2 was used. The discriminative ability of the models is quantified with the area under the curve (AUC); $p <$ .05 was considered statistically significant. Analyses were performed using SPSS Statistical Data software (IBM) version 25.

Results

Fall risk screening was performed for 216 patients, most of whom were patients from the ED (n = 116; figure 1). Seventy-nine participants (36.6%) had high fall risk, 77 (35.6%) indicated they had experienced a fall in the previous year, and 34 (15.7%) participants had fallen twice or more. Whereas 112 participants (51.9%) had mobility problems, 58 (26.9%) indicated fear of falling. No difference in risk was seen between patients attending the ED and NOC; however, the frequency of falls in the last 12 months was higher among patients attending the ED (ED: 42.2% vs. NOC: 28.3%, p = .033).

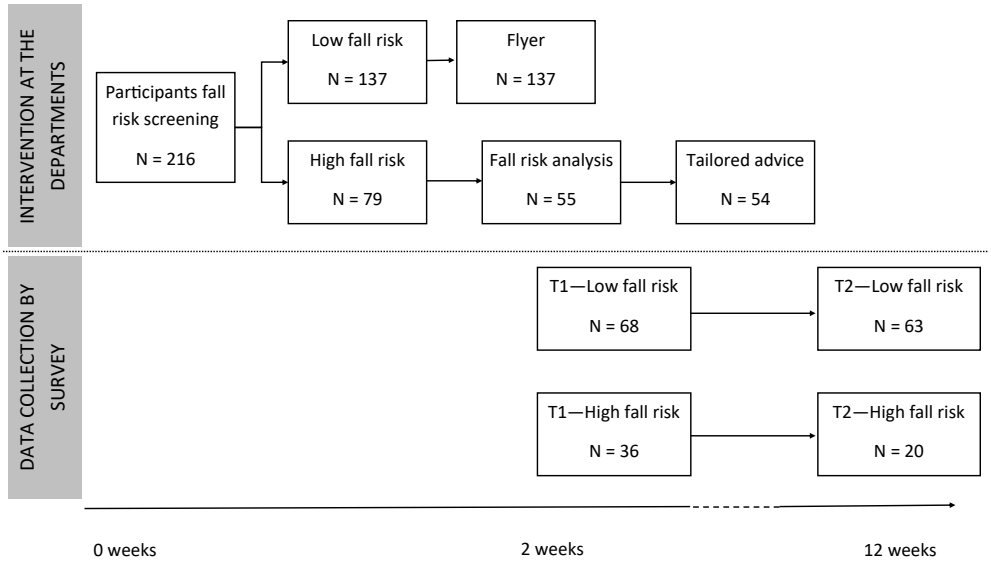

Figure 1. Patient flowchart

Characteristics and health-related quality of life

Of 216 patients screened, 104 (48.1%) responded to the baseline survey (T1). Of these, 68 (65.4%) had low fall risk and 36 (34.6%; $p = .002$) a high risk. Baseline characteristics of these patients, collected at T1, are in table 1. Patients with high risk had more problems in all domains regarding reported health-related quality of life, with the largest difference being for mobility (high: 97.1% vs. low: 47.7%, $p \leq .001$). Participants with high fall risk had a significantly lower EQ-5D utility score than participants with low fall risk (high: 0.50 vs. low: 0.80, $p \leq .001$). In addition, patients with high risk had lower VAS scores (high: 55 vs. low: 70, $p \leq .001$). Furthermore, a difference in the prevalence of chronic conditions was observed. Patients with high fall risk suffered more often from two (high: 31.4% vs. low: 14.1%, $p = .040$) and three or more (high: 54.3% vs. low: 12.5%, $p \leq .001$) chronic conditions compared with patients with low fall risk.

Fall risk factors

Of all patients with high fall risk ($n = 79$), 55 (69.6%) participated in the comprehensive analysis that identified personal risk factors. Most of these 55 high-risk patients were at risk in the mobility and balance domains (92.7%) and medication use (92.5%). Furthermore, a history of falls was a common risk factor (85.5%). Table 2 presents an overview of all risk factors. The risk factors medication and painful feet were present more often in patients from the NOC compared with patients from the ED, whereas dizziness was less frequent in patients from the NOC vis-à-vis patients from the ED.

Table 1. Baseline characteristics with differences between patients with high and low fall risk

Characteristics N (%)	Total N = 104	Low risk patients N = 68 (65%)	High risk patients N = 36 (35%)	Difference, P [a]
Department				.633
ED	29 (27.9%)	20 (29.4%)	9 (25%)	
NOC	75 (72.1%)	48 (70.6%)	27 (75%)	
Sex (male) [1]	74 (72.5%)	52 (77.6%)	22 (62.9%)	.113
Dutch nationality (yes) [2]	88 (89.8%)	59 (89.4%)	29 (90.6%)	.850
Living together with partner or children (yes) [2]	75 (76.5%)	52 (81.3%)	23 (67.6%)	.130
Education [3]				
Low	49 (52.1%)	35 (54.7%)	14 (46.7%)	.468
Intermediate	27 (28.7%)	17 (26.6%)	10 (33.3%)	.499
High	18 (19.1%)	12 (18.8%)	6 (20%)	.886
Living situation [4]				
Independent	84 (86.6%)	58 (92.1%)	26 (76.5%)	.031
Independent + care	11 (11.3%)	4 (6.3%)	7 (20.6%)	.035
Care institution	2 (2.1%)	1 (1.6%)	1 (2.9%)	.654
Chronic conditions [5]				
0	18 (18.2%)	17 (26.6%)	1 (2.9%)	.003
1	32 (32.3%)	28 (43.8%)	4 (11.4%)	.001
2	20 (20.2%)	9 (14.1%)	11 (31.4%)	.040
3 or more	27 (27.3%)	8 (12.5%)	19 (54.3%)	<.001
EQ-5D + cognition [b] [6]				
Problems mobility	65 (65%)	31 (47.7%)	34 (97.1%)	<.001
Problems self-care	23 (23%)	5 (7.7%)	18 (51.4%)	<.001
Problems daily activities	47 (47%)	21 (32.3%)	26 (74.3%)	<.001
Pain/ discomfort	68 (68%)	39 (60%)	29 (82.9%)	.019
Anxiety/depression	33 (33%)	17 (26.6%)	16 (44.4%)	.068
Cognition [7]	48 (47.5%)	27 (41.5%)	21 (58.3%)	.105
Mean (SD)				
Age	75.0 (4.6)	74.4 (4.2)	75.9 (5.3)	.189
EQ-5D-5L utility [2]	0.69 (0.30)	0.80 (0.23)	0.50 (0.33)	<.001
VAS [8]	65 (19.4)	69 (17.8)	55 (18.8)	<.001

Note: ED = emergency department; NOC – nephrology outpatient clinic; EQ-5D-5L = five-dimensional EuroQol instrument + cognition; VAS = Visual Analog Scale.

[a] A Mann-Whitney U test was used for continuous data and a chi-square test for categorical data. [b] For the EQ-5D, domains were listed as a problem when patients answered they had slight problems regarding the domain or more than slight problems.

1. N=102, 2. N=98, 3. N=94 4. N=97, 5. N=99, 6. N=100, 7. N=101, 8. N=99.

P <.05 is considered statistically significant.

Table 2. Fall risk factors present in patient with high risk from the emergency department and the nephrology outpatient clinic and difference between patients from the two departments

Fall risk factor	Total N=55 N (%)	ED N=23 N (%)	NOC N=32 N (%)	Chi-square P
Mobility and balance	51 (92.7%)	21 (91.3%)	30 (93.8%)	.730
Medication [a]	49 (92.5%)	17 (81%)	32 (100%)	.010
Fall history	47 (85.5%)	21 (91.3%)	26 (81.3%)	.297
Vision [a]	31 (57.4%)	13 (59.1%)	18 (56.3%)	.836
Dizziness	30 (54.5%)	17 (73.9%)	13 (40.6%)	.014
Painful joints	30 (54.5%)	13 (56.5%)	17 (53.1%)	.803
Painful feet	29 (52.7%)	8 (34.8%)	21 (65.6%)	.024
Living environment	29 (52.7%)	11 (47.8%)	18 (56.3%)	.537
Fear of falling	27 (49.1%)	11 (47.8%)	16 (50%)	.874
ADL	22 (40%)	9 (39.1%)	13 (40.6%)	.911
Osteoporosis	19 (34.5%)	5 (21.7%)	14 (43.8%)	.090
Cognition	18 (32.7%)	10 (43.5%)	8 (25%)	.150

Note: A chi-square test was used for copmaring the presence of risk factors in patiënt from the ED and the nephrology department. ED = emergency department; NOC=nephrology outpatient clinic; ADL=challenges performing daily living activities.

[a] Number of risk factors present according to the additional fall analysis, administered to 55 of the 79 patients who were considered at high risk of falls..

P < .05 is considered statistically significant

Preventive actions

In all, 83 participants (low-risk *n* = 63 and high-risk *n* = 20) responded to the 3-month follow-up, with 51.8% indicating they had undertaken action to prevent falling following the screening. Of patients who had low fall risk and thus did not receive fall prevention advice, 46% indicated doing something to prevent falls, which was fewer than in the group receiving tailored advice (70%). Of the abovementioned 83 patients, 25 (30.1%) performed a preventive action without help from a health care provider, 11 (13.3%) contacted a medical specialist, and three (3.6%) contacted their GP for fall prevention. Figure 2 shows an overview of actions performed by patients after screening. Strength and endurance training was undertaken most often (12.0%), with vision checkups (8.4%) being next in frequency. Of the 20 patients with high risk who received personal prevention advice, strength and endurance training together with adjustments in and around the house ranked first in frequency (20%); vision checkup and information collection (15%) stood second.

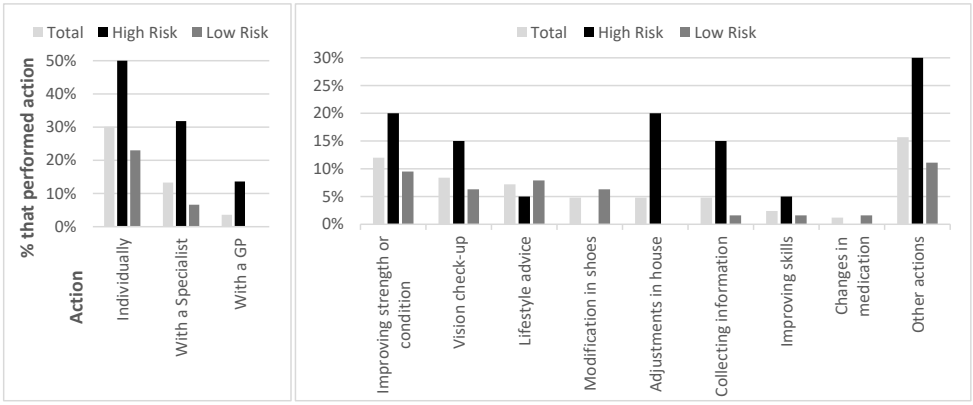

Figure 2. Percentage of patients indicating they had taken action after a hospital fall risk screening.
Note: GP=general practitioner.

The actions patients undertook did not always align with the tailored advice they received. When patients were advised to consult a GP, 16.7% did so, whereas 42.1% visited another health care provider to prevent falling. When specific advice was given, patients adhered most often to improving strength and or balance (22.2%), but less to vision checkup (20.0%), training to improve skills (12.5%), and adjustments in and around the house (10%).

Which patients take action

Increasing age, presence of chronic conditions, tailored prevention advice, and a reported poorer quality of life are associated with taking action to prevent falls (table 3). However, after controlling for other characteristics in a multivariate model (Nagelkerke R^2 = .313, AUC = .792), the effect of the tailored advice disappears and only the presence of chronic conditions is associated with a higher likelihood of taking action after screening (odds ratio [OR] = 7.37, 95% confidence interval [CI] = [1.32, 41.06], p = .023). Both tailored advice (OR = 10.14, 95% CI = [2.12, 48.42], p = .004) and lower EQ-5D utility score (OR = 0.070, 95% CI = [0.01, 0.91], p = .042) are associated with taking action with a health care provider's aid, after controlling for other characteristics in a multivariate model (Nagelkerke R^2 = .391, AUC = .857).

Table 3. Association between preventive action and participant characteristics

	Univariate model			Multivariate model			
Characteristics	Pseudo R^2	OR (95% CI)	P	Pseudo R^2	OR (95% CI)	P	AUC
Action: Did something to prevent falling							
Age	.093	1.133 (1.019-1.260)	.021		1.134 (.997-1.291)	.056	
EQ-5D utility score	.159	.044 (.004-.428)	.007		.260 (.022-3.113)	.260	
Chronic conditions	.175	9.250 (1.923-44.503)	.006		7.373 (1.324-41.055)	.023	
Tailored advice yes	.056	2.833 (.975-8.231)	.067	.313	1.228 (.336-4.490)	.765	.792
Action: Went to healthcare worker to prevent falling							
Female	.036	2.366 (.660-8.481)	.186		1.087 (.199-5.935)	.923	
EQ-5D utility score	.117	.038 (.005-.322)	.003		.070 (.005-.913)	.042	
Tailored advice yes	.142	10.545 (2.700-41.184)	.001	.391	10.140 (2.123-48.421)	.004	.857
Action: Undertake actions to prevent falling without a healthcare worker							
Dutch nationality	.048	.304 (.074-1.254)	.100		.227 (.036-1.427)	.114	
EQ-5D utility score	.066	.178 (.030-1.064)	.058		.427 (.046-3.933)	.452	
Chronic conditions	.105	7.700 (0.948-62.528)	.056		5.930 (.552-63.710)	.142	
Tailored advice yes	.090	3.556 (1.218-10.376)	.020	.227	2.849 (.797-10.181)	.107	.725

Note: Nagelkerke R^2 is used for assessing model goodness-of-fit. AUC is used to quantify discriminative ability of the models. AUC = area under the curve; OR = odds ratio; CI = confidence interval; EQ-5D = five=dimensional EuroQol instrument.

Discussion

The fall risk screening at both ED and NOC revealed an equally large percentage of older adults with high fall risk. These patients with high risk had a poorer reported quality of life and substantially more mobility problems and more of them suffered from comorbidity than patients with low risk. Most fall risk problems were in the mobility and balance, medication, and fall history domains. After screening, more than half the patients took action to prevent falls but not always according to the tailored advice. When patients adhered to the advice, it was most often to improve balance or strength or have their eyes tested. Although tailored advice was not associated with undertaking fall prevention actions in general, it was associated with consulting health care providers about fall prevention.

When patients were at risk of falling and received individual prevention advice, 70% took action to prevent falling. Considering the relatively simple intervention, these percentages hold out hope. Elliott et al. [42] found similar percentages (73%). However, Elliot's participants visited a fall prevention event of their own accord, suggesting prior motivation regarding fall prevention. A study in an ED setting by Phelan et al. [43] also found slightly higher percentages (73%–79%) of patients undertaking preventive action. However, these patients were included after a fall. This could have increased perceived personal relevance and motivation to change. Shah et al. [44] found much lower percentages after screening and educational information (15%). In the study of Shah et al., educational information was generalized instead of tailored, thus potentially affecting uptake [26]. In the current

study, tailored advice was not always adhered to. However, a slight increase in intensity, such as information, physical tests, and one-on-one reviews of personal recommendations prompted considerably higher adherence percentages [45], as did a few home visits [26].

Patients with high risk who received tailored advice more often undertook preventive action. However, after correcting for other characteristics, the presence of chronic conditions was associated with such action rather than tailored advice. That chronic conditions were associated with undertaking action can be seen as remarkable, because a medical condition normally is associated with limited physical activity among older adults [46,47]. Contrarily, patients with chronic conditions are already more aware of their health status and in contact with health care professionals and, perhaps, are more inclined to undertake action, whereas healthy older adults might not identify with fall prevention and, therefore, do not undertake action. High fall risk and thus tailored advice are predictors for consulting a health care provider for fall prevention and, after receiving advice to visit a GP, 42% did visit a health care provider. Regrettably, because the advice was given for multiple risk factors, we do not know whether patients consulted with the health care provider for the specific risk factor we advised.

Screening on fall risk is much more common in ED settings than at other hospital departments [23]. To the researchers' knowledge, this is the first study to investigate fall risk and actions of patients in two different hospital settings. Given the finding that no differences in fall risk were seen between patients screened in ED or NOC, fall risk among older adult patients should receive the same degree of attention within an outpatient department. Furthermore, the study did not focus on those on a fall-related visit, but rather on primary prevention by inviting all older adults visiting either of the two departments.

This study has several limitations. Although many patients took fall prevention action after screening, we do not know what exactly prompted such action. It could be not only the screening itself but also the additional tailored prevention advice that inspired patients. Furthermore, it is unknown whether this was the first time the patients were confronted with their fall risk status. Because we do not know whether the information regarding their risk status was new to the patient, it is hard to say at follow-up whether this has been the (only) trigger for action. Moreover, we were unable to perform a pre- versus postscreening comparison because comparable data of fall risk and preventive actions were not assessed at baseline. Another limitation is the low response rate to the second questionnaire, which made the follow-up cohort, particularly of patients at high risk, quite small. Although based on our sample size calculation, an adequate number of older adults were invited (216 instead of 183), due to dropouts, we were eventually short of participants. The assessed fall risk among this population (37.5%), response rate (65%), and dropouts expected until baseline (15%) were all estimated well. However, among the high-risk population, the

dropout rate from baseline until follow-up was higher than expected (at 42% instead of 15%). Patients dropping out were those with chronic conditions and a poorer health-related quality of life—aspects that are associated with performing preventive actions or preventive actions with help from a health care worker; so, this might have affected outcomes. The high dropout rates also hinder drawing conclusions about patients' adherence to the specific advice and whether some advice was adhered to better than others. We noticed that, within hospital settings, compliance among older adults is low and retaining the cohort seems difficult. Finally, there was an unequal distribution of participants from the two departments. Patients attending NOC appeared more inclined to participate. This could be due to the process of obtaining informed consent, which was done immediately after screening at the NOC but by post at the ED. Besides, patients attending ED were present because of an acute situation concerning their health, which may have affected their willingness to participate.

For future in-hospital fall prevention programs, it is important to retain the cohort. To do so, additional analyses should be scheduled directly after screening. Studies could investigate adherence to specific advice, using a larger cohort. Furthermore, building on the risk factors presented in the current study, future studies could investigate whether these factors can predict future falls. However, adherence to fall prevention remains a major challenge in which health care providers are key. A bit more personal attention could potentially increase adherence to given advice.

Conclusion

Within this hospital population, a large percentage had high fall risk. This indicates that besides ED, departments with patients with chronic disease also have great potential to screen older adults for fall risk. Patients who receive tailored advice are motivated to undertake action to prevent falling. In particular, patients with high risk who received tailored advice are more likely to consult a health care provider. With more personal attention from health care providers, interventions have the potential to also increase adherence. However, future research should investigate why patients do or do not adhere to such tailored advice.

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Appendix

Table 1. Fall risk factors, advice and action

Risk domain	When a risk factor	Advice	Action
Medication	Psychotropic or cardiovascular medication	General practitioner	Visit GP
Mobility and balance	Problems with movement, balance or the use of walking aids.	Fall prevention programs in balance or falls in the past fall with application form.	Program to improve strength and/ or condition
Feet	Painful feet	General practitioner	Visit GP
Vision	Difficulty reading or looking far away or last year never let the eyes checked	Tips: have you eyes measured every year and keep your glasses close while resting or sleeping.	Eyes measurement
Living environment	>1 answered with no • Use of solid stepladder instead of chairs • Sturdy footwear • Doorsteps removed or chamfered • House properly lit • Lights on during the night • Loose rugs with anti-slip • Raised chairs, bed and sofa's. • Anti-slip in bathroom and toilet • Support in bathroom and toilet • Handrails on both sides of the stairs	A form with adjustments • The use of a stepladder instead of chair or stool • Remove or skew doorsteps • Turn on the light when leaving your bed during nights • Remove loose rugs or attach anti-slip • A good chair or sofa helps with getting up, is raised and with armrest. Chose a high bed with support. • Take care of good support • It is most save with handrails on both sides of the stairs	Adjustments in the house
Joints	Painful joints	• Regular exercise • Alternate day with rest and activities • Walking aids • Talk about possible painkillers with your GP	Visit GP
Fear of falling	Worried, insecure or anxious to fall	Fall prevention program a matter of balance with application form	Program to improve skills
Osteoporosis	>2 points • BMI <20 = 1 • 1 bone fracture for fiftieth = 1 2 bone fractures for fiftieth = 2 • Bone fracture within last 2 years = 4 • Swirl collapse = 4 • Fallen > 2 times last year = 1 • Broken hip with one of your parents = 1 • Prednisone for more than 3 months = 4 • The use of vitamin D = 1	General practitioner	Visit GP

Dizziness	Suffer from dizziness (vertigo)	• Try to keep doing daily things • Do not suddenly get up out of bed or chars, first contract muscles • Maintain muscle strength and condition by regular walking or cycling • Do not wear reading glasses while walking around • If you suddenly feel dizzy, it is best to sit down • Eat healthy, to maintain glucose levels • Do not smoke and drink little/no alcohol	No specific action
Memory	Memory complaints	• If you want to concentrate, make sure you're not getting distracted • Do one thing at the same time • Try to cycle or walk for half an hour each day	No specific action
Challenges performing daily life activities	Not able to wash, dress, move, visit the toilet or eat alone or is incontinent for urine	General practitioner	Visit GP
History of falls	Fallen in the last 12 months	General practitioner	Visit GP

Fall risk domains with explanation when the risk domain counts as risk factor (when a risk factor), which advice is given (advice) and which action is linked to the advice (action).

4

Implementation of cardiovascular risk assessment as preventive care in a hospital setting: a patient perspective

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Submitted

Abstract

Background: Patients with a potential high-risk of cardiovascular diseases who could benefit from cardiovascular risk assessment and prevention commonly visit hospitals. This study, 1) explored patients' perspectives on cardiovascular risk assessment in an outpatient clinic of a hospital and 2) examined changes in patients' lifestyle behavior and their perception of cardiovascular diseases.

Method: Patients visiting the outpatient rheumatology department (primary prevention) or an outpatient vascular surgery department (secondary prevention) were screened for ten years' risk of developing or aggravating cardiovascular diseases. Patients received their results and a personal prevention advice. High-risk patients were invited for a consult to discuss lifestyle factors. Patients completed a survey to assess barriers and facilitators of screening. A summary index (1=barrier until 5=facilitator) was calculated for; healthcare worker, patient, context and program characteristics. After three months, lifestyle changes and perceptions about cardiovascular diseases were assessed.

Results: Screening was completed by 337 patients of which 266 (79%) had a high or very high risk of cardiovascular diseases. Patients reported 14 out of 17 statements as facilitator and none as barrier. Of all patients, 24.2% and of patients that attended the consultation to discuss lifestyle 42.5% reported changes. Seventy-five percent reported to be more open for advice.

Conclusion: Patients have a positive attitude towards the screening but only a few reported changes. More intensive lifestyle interventions have the potential to lead more patients towards behavioral change.

Background

Globally, cardiovascular diseases (CVDs) are the number one cause of death [1] and also the leading cause of disability-adjusted life years [2]. Annually, CVD leads to 17.9 million deaths, accounting for 31% of all deaths worldwide [1]. In Europe, CVD leads to more than four million deaths annually, accounting for 45% of all deaths [3]. In the Netherlands, the absolute number of deaths in 2018 was 37.795 [4], which accounted for 24% of total deaths in men and 25% of total deaths in women [5].

Prevention of CVD has shown to be effective [2,6]. Prevention focusses on reducing major risk factors of CVD, such as obesity and diabetes mellitus. The high prevalence of these risk factors is also the main challenge in preventing CVD [7,8]. Within preventing CVD, there are two important factors, namely lifestyle modification and medical treatment. Lifestyle modification includes physical activity, a healthy diet, absence from smoking, weight control and absence of alcohol use. Medical treatment includes lipid-lowering therapy, anti-hypertensive therapies, blood glucose medication and antiplatelet therapy [9].

Cardiovascular risk assessment is an important step in the prevention of CVD. Many individuals are unaware of their increased risk, therefore risk awareness is the first step for primary prevention of CVD [10]. In addition, information about risk factors and how to manage these risk factors is often unknown among patients with established coronary artery disease. Awareness and knowledge of their risk and risk factors is of crucial importance for secondary prevention [11]. The European guideline recommends systematic cardiovascular risk assessment, targeted at populations with an increased risk [6]. The Dutch guideline 'cardiovascular risk management' used by general practitioners (GPs) is largely in line with this European guideline. Although GPs regard cardiovascular risk assessment as useful and primarily their responsibility [12], 37% of Dutch GPs do not have an opportunity to take proactive action to perform cardiovascular risk management [13]. Lack of time is most often the barrier to estimate cardiovascular risk [13]. Not only general practices, but also hospitals are commonly visited by patients with a high-risk of CVDs who could benefit from cardiovascular risk assessment and prevention. However, it is unknown whether patients who are visiting the hospital for another illness are willing to be screened for cardiovascular risk factors during their hospital visit. Therefore, the aims of this study are to: 1) explore patients' perspectives on cardiovascular risk assessment in an outpatient clinic of a hospital and 2) examine changes in patients' lifestyle behavior and their perception of CVDs. Moreover, similarities and differences between implementation of primary and secondary prevention are investigated.

Methods

Study design and population

In this longitudinal observational study, a CVD screening program was implemented between October 2017 and February 2018. Screening was performed at two departments within the Erasmus Medical Centre, Rotterdam, the Netherlands. In order to investigate similarities and differences between implementation of primary and secondary prevention, the departments 1) rheumatology, focusing on primary prevention of a high-risk group and 2) vascular surgery, focusing on secondary prevention were selected. The medical ethics committee of the Erasmus Medical Centre, Rotterdam reviewed the study and waived ethical approval (2017-350). The study complied with the principles outlined in the Declaration of Helsinki and all patients that participated provided informed consent.

Screening

At both departments, patients were screened for their risk of developing or aggravating CVD. This screening was conducted by a research assistant using a mobile application. The Systematic Coronary Risk Evaluation (SCORE) risk estimation was used for primary prevention at the rheumatology department to calculate the 10 years risk of a fatal CVD event. The risk was based on the factors age, gender, smoking, systolic blood pressure and total cholesterol. Since CVD risk of patients with rheumatology is comparable with the CVD risk of patients with diabetes mellitus, for the SCORE risk calculation patients' age is increased with 15 years to give a more realistic outcome [14]. The Secondary Manifestations of ARTerial disease (SMART) risk estimation was used for secondary prevention at the vascular surgery department to calculate the 10 years risk of a recurrent vascular event. Besides the factors used in the SCORE estimation, risk was based on HDL cholesterol, glomerular filtration rate, C-reactive protein, the years since the first cardiovascular event and the type of event [15]. If no recent blood measures existed (< 1 month ago), patients were asked to undergo a blood test to provide the information about risk factors mentioned above. Patients were allocated to a three-level risk profile based on the SMART/SCORE system: 1. low- to moderate risk (<10%), 2. high-risk (10-<20%) and 3. very-high-risk (≥20%) for developing a (recurrent) cardiovascular event within 10years. In addition to factors needed for the risk estimation, Body Mass Index (BMI) was measured and physical activity asked in order to provide personal prevention advice. After cardiovascular risk assessment, all patients received a letter with the results of the screening and a leaflet with personal prevention advice aimed at a healthy lifestyle. The prevention advice focused on increasing their physical activity (at least five days a week, 30 minutes a day), improving their diet (based on recommendations of the Dutch Heart Foundation), smoking cessation and/or medication changes based on LDL (<1.8 mmol) and systolic blood pressure (<140 mmHg). The advice was simplified with colors and smileys to make the results and advice understandable for all patient groups visiting the hospital (see appendix file 1). High-risk and very-high-risk (≥10%) patients were also invited

for a one-time personal motivational interviewing consult to talk in more detail about the personal prevention advice they received. If necessary, the personal prevention advice was supplemented with coaching at a smoking cessation clinic and/or an appointment with a dietician. Moreover, based on their laboratory results the medication use of all patients screened at the department of vascular surgery (with pre-existing CVD) was evaluated by an internist specialized in CVD and if necessary, a medication change was prescribed. Lastly, patients' GP was notified about the screening results. They received a letter with a short summary of the screening results and the prevention advice. This way, the GP had the necessary background information in case the patient would contact the GP to discuss the results and upcoming steps. The GP was also free to contact the patient themselves should they consider that results required further action.

Study population

The study population consisted of two patient groups from different outpatient clinics, i.e. the department of rheumatology and the department of vascular surgery. These departments were selected to investigate the differences and similarities between primary (rheumatology) and secondary (vascular surgery) preventive screening. At the department of rheumatology patients were eligible for screening if 1) they were diagnosed with rheumatoid arthritis (RA), spondyloartritis (SA), or artritis psoriatica (AP); 2) age ≥25 years; and 3) not previously diagnosed with CVD. At the department of vascular surgery patients were eligible for screening if 1) they were diagnosed with peripheral arterial disease; and 2) age ≥40 years. Patients were excluded if they had a glomus tumor, arteritis temporalis, thoracic outlet syndrome, vascular injury upper extremities, lymphedema of extremities, varices of lower extremities, chronic venous insufficiency, posttrombotic syndrome, deep vein thrombosis, pulmonary embolism, ulcus cruris, varicose veins, chronic deep vein pathology and acute deep vein pathology. For both departments, incapacitated patients were excluded.

Measurements

Outcomes related to patients' participation in the prevention program, the extent that the patients are at risk of dying from a CVD in the next 10 years (rheumatology patients), and the extent that the patients are at risk of a recurrent cardiovascular event in the next 10 years (vascular patients) were collected by file-research and observation.

Patients' perspectives on CVD screening

Patients were asked to participate in the research project to evaluate the CVD screening which included completing a survey directly after screening and at three months. Once informed consent was signed, patients could complete the first survey on paper or tablet in the waiting room. The survey included questions to assess patients' perspectives, including the barriers and facilitators for participating in the CVD screening program. A narrative

literature search was performed on patient reported barriers and facilitators of CVD screening and prevention. Based on the literature search and the 'Barriers and Facilitators Assessment Instrument' by Peters et al. [10] a survey was developed. It includes seventeen statements to assess structural-, organizational-, patient-, provider- and intervention-level barriers and facilitators for CVD screening and prevention. Participants were asked on a five-point Likert scale ranging from totally disagree to totally agree how they felt about the statements. Statements were defined as barriers if ≥50% of the respondents (totally) disagreed with the positive statements; or ≥50% of the respondents (totally) agreed with the negative statement. Statements were considered as facilitator if ≥50% of the respondents (totally) agreed with the positive statements; or ≥50% of the respondents (totally) disagreed with the negative statements. In addition, summary scores for four different dimensions (healthcare worker, patient, context and program characteristics) within the survey were calculated. Negative statements were recoded and a summary index was calculated by dividing the sum score of statements by the number of statements in each dimension. The summary index ranges from 1 (very possible being a barrier) to 5 (very possible being a facilitator).

Three months after screening patients were asked to complete a second survey at home, which was sent by mail or email. The survey included nine statements to assess patients' perceptions of CVD risk, prevention and screening. Again, participants were asked on a five-point Likert scale ranging from totally disagree to totally agree how they felt about these statements. Furthermore, within the survey, patients were asked about potential changes in lifestyle and medication. Lifestyle changes included increased physical activity, tried to lose weight, quit smoking, reduced smoking, improved diet, visited a dietician, reduced salt intake and started measuring own blood pressure.

Statistical analysis

Frequencies (N, %) were calculated to show patients' participation in the prevention program, the extent that patients were at risk of dying from a CVD in the next 10 years (rheumatology patients) or at risk of a recurrent cardiovascular event in the next 10 years (vascular patients), and the number of patients who reportedly changed their lifestyle after having participated in the CVD screening program. In addition, to assess which factors were considered as barriers or facilitators, frequencies (N, %) of the replies (totally) agree and (totally) disagree to all statements were calculated. To compare responses in statements of patients screened for primary and secondary prevention, chi-squared tests were performed. Summary index of domains are expressed as median and Inter Quartile Range. To examine the difference in summary index between primary and secondary prevention a Mann-Whitney U test was performed. To examine associations between patients' attitude and lifestyle changes phi correlation coefficient was used. Data were analyzed using SPSS Statistical data software (IBM) version 25.

Results

During the study period 1025 patients visited the rheumatology (n=611) or vascular surgery (n=414) outpatient clinic. Of them, 614 were potentially eligible for cardiovascular screening (rheumatology; n=289 (47.6%) / vascular surgery; n=325 (79.9%)). Ineligible rheumatology patients were not diagnosed with RA, SA or AP (n=218) or they were previously diagnosed with CVD (n=50). Ineligible vascular surgery patients were not diagnosed with peripheral arterial disease (n=37) or pre-screening variables (such as other diagnosis) were missing (n=42). Of the eligible patients, 22% refused to participate and 10.7% were missed by the researcher. In total, 411 eligible patients were included in the study and screened for their cardiovascular risk (rheumatology; n=208 / vascular surgery; n=203). Due to missing values of 74 patients (rheumatology; n=2 (1.0%) / vascular surgery; n=72 (35.5%)), mostly due to missing lab values, CVD risk could be calculated for 337 patients. Of the 337 patients that were screened, 266 (78.9) had a high or very high risk of developing or aggravating CVD (rheumatology; n=136 (66.0%) / vascular surgery; n=130 (99.2%)). A schematic overview of the screening and analyses can be found in figure 1. Of the screened patients, 57.9% had an elevated BMI, 35.5% did not meet guidelines for physical activity and 25.1% smoked. Furthermore, LDL levels of 80.5% of the patients and systolic blood pressure of 54.7% of the patients were above target. Figure 2. Patient flowchart. Patients screened and screening results.

Barriers and facilitators

Of the 411 patients who were screened (rheumatology n=208 and vascular surgery n=203), 252 (rheumatology n=133 and vascular surgery n=119) completed the questionnaire regarding the barriers and facilitators patients experienced in relation to screening CVD risk at the departments. Overall, most factors were reported as facilitators by patients. Although this was observed in both patient groups, there were several differences between the two groups. Patients from the vascular surgery department (secondary prevention) more often reported that healthcare workers have the right skills (72.3% vs 55.6%, $p < 0.001$), knowledge (74.8% vs 53.4%, $p < 0.001$) and that CVD screening belongs to the duties of the healthcare workers (specificity, flexibility) (76.5% vs 48.9%, $p < 0.001$). In addition, they more often reported that there is enough supportive staff (51.3% vs 20.3%, $p < 0.001$), that the department is the appropriate place for CVD screening (facilities) (77.3% vs 59.4%, $p < 0.001$) and that patients themselves have enough time to be screened (time investment) (79.8% vs 72.9%, $p = 0.016$). On the other hand, patients from rheumatology (primary prevention) more often reported that they have no problem with the fact that healthcare workers interfere with their health status without asking (55.5% vs 78.9%, $p = 0.001$) and that they believe that screening and detecting risk can prevent them from developing CVD in the future (specificity, flexibility) (56.3% 72.2%, $p = 0.007$).

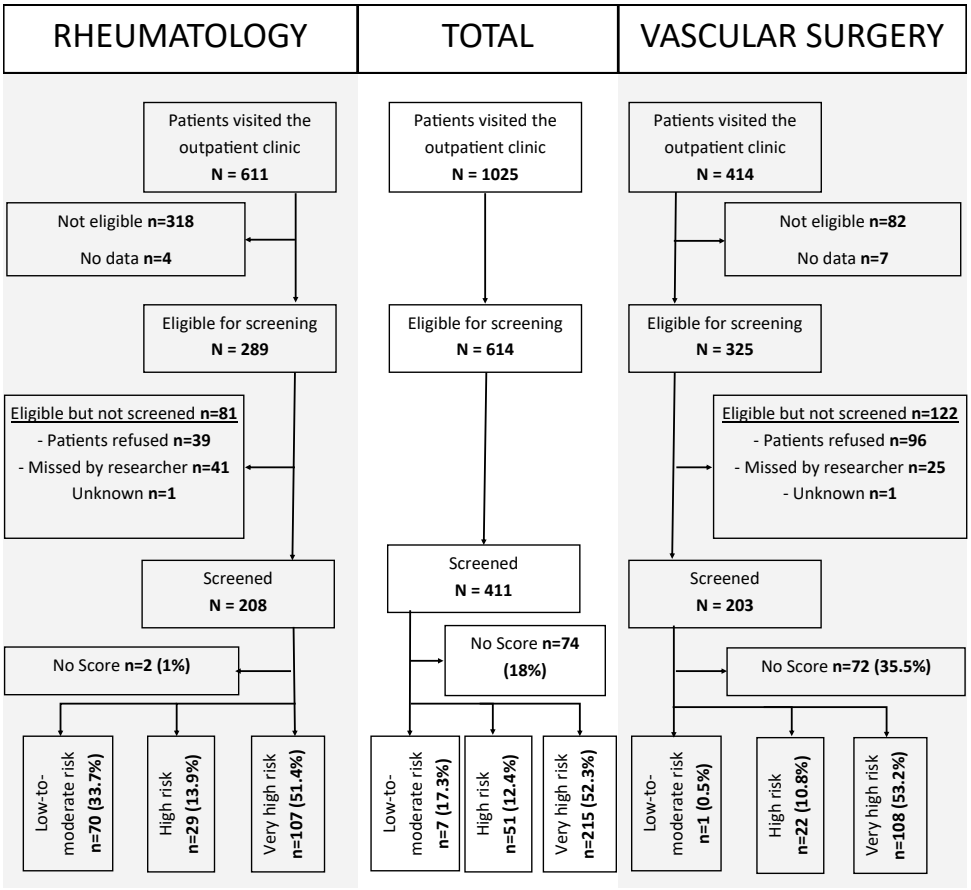

Figure 1. Patient flowchart. Patients screened and screening results.

Patients who were screened for secondary prevention of CVD (vascular surgery) reported 15 of the 17 factors as facilitator and none as barrier. Most patients reported that they have enough time for CVD risk screening (time investment: 79.8%), patients disagreed that early detection of disease is not concordant with culture and/or values (ethnicity: 77.3%) and they agreed that the department of vascular surgery is an appropriate place for CVD risk screening (facilities: 77.3%).

Patients who were screened for primary prevention of CVD (rheumatology) reported 13 of the 17 factors as facilitator and none as barrier. Similar to the patients from the vascular surgery department they disagreed on the statement that early detection of disease is not concordant with culture and/or values (ethnicity: 94.0%). Furthermore, most patients disagreed with the statement “I do not appreciate it when people interfere with my health without asking“ (health status: 78.9%) and they agreed on the statement “I expect to benefit

from CVD risk screening" (attractiveness: 76.7%). An overview of patients' responses can be found in table 1.

Differences between domains

When comparing the summary index of the four domains (i.e., healthcare worker, patient, program and context characteristics) between the two departments, differences in the healthcare worker and context domain are observed. Healthcare worker characteristics (4 (3.5-4.3) vs 3.7 (3.0-4.0) p <.0001) and context characteristics (3.8 (3.5-4.0) vs 3.5 (3.3-4.0) p <0.001) are more possibly a facilitator among patients that were screened for secondary prevention (vascular surgery) than among patients screened for primary prevention (rheumatology).

Perceptions on CVD risk and screening

At three-month follow-up, patients reported to be more open to advice to prevent CVD (74.5%), to have a more positive attitude towards CVD screening (73.0%), to be more inclined to take action (72.3%) and they reported being more aware of the risk of CVD (72.3%). Compared to patients from the rheumatology department, patients from the vascular surgery department more often reported feeling more self-sufficient (60.0% vs 37.7%, p = 0.005), having more knowledge of actions they can do to prevent CVD (73.8% vs 55.7%, p = 0.013), having a more positive attitude toward CVD risk screening (80.0 vs 63.9%, p = 0.016) and feeling more capable of preventing CVD (65.0% vs 47.5%, p = 0.018). An overview of patients' perceptions on CVD risk and screening can be found in table 2.

Table 1. Barriers and facilitators as experienced by patients.

		All patients (n=252)		Rheumatology (n=133)		Vascular surgery (n=119)		Chi-square
Negative statements	Domain	agree %	disagree %	agree %	disagree %	agree %	disagree %	p-value
Skills: HCW at the department do not have the right skills to screen for risk of CVD	HCW	9.9	**63.5**	8.3	**55.6**	11.8	**72.3**	<.0001
Knowledge: HCW at the department do not have the right knowledge to screen for risks of CVD	HCW	7.5	**63.5**	8.3	**53.4**	6.7	**74.8**	<0.001
Health status: I do not appreciate it when people interfere with my health without asking me	Patient	15.9	**67.9**	8.3	**78.9**	24.4	**55.5**	0.001
Ethnicity: Early detection of disease is not concordant with my culture/ values	Patient	4.8	**86.1**	3.0	**94.0**	6.7	**77.3**	0.111
Financial status: I am afraid CVD risk screening will cost me money	Context	6.0	**65.9**	13.5	**65.4**	13.4	**63.9**	0.554
Compatibility: I think CVD screening is executed at an inconvenient time	Program	8.7	**71.4**	10.5	**75.9**	6.7	**66.4**	0.371
Attractiveness: I have negative expectations of CVD risk screening	Program	6.0	**65.9**	6.0	**71.4**	5.9	**59.7**	0.628
Specificity, flexibility: I do not believe that CVD risk screening can prevent CVD in the future	Program	11.5	**64.7**	6.0	**72.2**	17.6	**56.3**	0.007
Didactive benefit: Since I have been screened for CVD risk, I am not going to prevent CVD in a more active manner	Program	21.8	46.8	17.3	47.4	26.9	46.2	0.011
Positive statements	Domain	agree %	disagree %	agree %	disagree %	agree %	disagree %	p-value
Specificity, flexibility: CVD screening is part of the duties of the health care workers at the department	HCW	**61.9**	11.9	48.9	16.5	**76.5**	6.7	<0.001
Attractiveness: I expect to benefit from CVD risk screening	Program	**75.4**	6.3	**76.7**	6.0	**73.9**	6.7	0.349
Time investment: I have enough time for CVD risk screening	Context	**76.2**	7.1	**72.9**	9.8	**79.8**	4.2	0.016
Supportive staff: There is enough staff at the department for CVD risk screening	Context	34.9	11.5	20.3	12.0	**51.3**	10.9	<.001
Facilities: The department is an appropriate place for CVD risk screening	Context	**67.9**	11.1	**59.4**	12.0	**77.3**	10.1	<0.001
Group norms, socialization: People who I appreciate would undergo CVD risk screening	Context	**52.0**	8.3	**51.1**	6.0	**52.9**	10.9	0.081
Motivation: I have a need for CVD risk screening	Patient	**66.3**	8.3	**69.2**	7.5	**63.0**	9.2	0.735
Motivation to change: Since I have been screened for CVD risk, I am more aware of my risk of CVD	Patient	46.4	20.2	44.4	25.6	48.7	14.3	0.149

Note: Percentage of patients that agree or disagree with statements directly after screening and differences between patients form rheumatology and vascular surgery. Italic=Topic of statement, Bold numbers=Facilitator or barrier. HCW=healthcare worker domain, CVD=cardiovascular disease. A p-value of <0.05 is considered statistically significant.

Table 2. Percentages of patient that agree with statements of CVD risk, screening and prevention.

Statements	Total (n=141) %	Rheumatology (n=61) %	Vascular surgery (n=80) %	Chi-Square
I am more aware of the risk of CVD	72.3	70.5	73.8	0.668
I have more knowledge of action I can do to prevent CVD	66.0	55.7	73.8	0.013
I have a more positive attitude towards CVD risk screening	73.0	63.9	80.0	0.016
I am more open to advice to prevent CVD	74.5	68.9	78.8	0.140
I am more inclined to take action to prevent CVD	72.3	67.2	76.3	0.187
I can count on more understanding and/or help from those around me to prevent CVD	50.4	44.3	55.0	0.155
I feel more capable in preventing CVD	57.4	47.5	65.0	0.018
I feel I am more self-sufficient	50.4	37.7	60.0	0.005
I did things to prevent CVD	62.4	60.7	63.8	0.566

Note: Responses of patients three months after screening and differences between the rheumatology and vascular surgery department. CVD=cardiovascular disease. A p-value of <0.05 is considered statistically significant.

Lifestyle changes

Of the 266 patients with a high or very high risk of developing or aggravating CVD, 223 patients (rheumatology n=111 (49.8%) and vascular surgery n=112 (50.2%)) had modifiable risk factors such as smoking, low levels of physical activity or BMI ≥25 kg/m². All these patients received tailored prevention advice and were invited for a consultation to talk about these lifestyle factors. In total, 127 patients (rheumatology n=84 (75.7%) and vascular surgery n=43 (38.4%)) accepted the invitation of which 120 (rheumatology n=77 (91.7%) vascular surgery n=43 (100%)) attended.

At three-month follow-up, 54 (24.2%) patients whose risk was high or very high and had modifiable risk factors reported having made one or more lifestyle changes to prevent CVD. Patients from the rheumatology clinic reported more often lifestyle changes than patients from vascular surgery (12.5% vs 36%, p<0.001). Lifestyle changes that were reported most often were; increased physical activity (10.8%), improved diet (9.9%) and tried to lose weight (7.6%). Of the 120 patients that attended the personal motivational interviewing consult to talk in more detail about the personal prevention advice they received, 42.5% reported having made lifestyle changes. For both patient groups, a positive association was found between attending the personal motivation interviewing consult and lifestyle changes (rheumatology, $\phi = 0.377$, $p < 0.001$, vascular surgery, $\phi = 0.479$, $p = < 0.001$). Moreover, with patients from the rheumatology department, we found a positive association between risk awareness and self-reported lifestyle changes ($\phi = 0.407$, $p = 0.019$). Also being more inclined to take preventive action is associated with making lifestyle changes ($\phi = 0.407$, p =

0.019) in this patient group. These associations were not seen within patients screened at the vascular surgery department.

In addition to lifestyle changes, some patients started or changed medication after screening. For starting or changing medication, different approaches applied for the different departments. Patients from the rheumatology department (primary prevention) were advised to talk with a GP to start or change medication when indicated by screening results (Systolic Blood Pressure ≥140, and LDL≥1,8). This resulted in six patients (5.4%), who changed or started medication after visiting the GP. Laboratory results of all patients (n=203) screened at the vascular surgery department (secondary prevention) were checked by an internist. For 58 (28.6%) patients no further actions were necessary based on the laboratory results. Of the remaining 145 patients, lab values indicated a change in medication was necessary. When medication change was necessary, the following interventions took place: five patients (2.5%) were advised to visit the vascular internist; to 50 patients (24.6%) new medication prescriptions were given that were made by the vascular internist; and 98 patients (48.3%) were advised to make an appointment with the GP to discuss medication. To eight patients both new medication prescriptions by the vascular internist were given as well as the advice to visit the vascular internist or GP.

Only a minority of the patients followed the medication advice which was provided: of the 50 patients who received prescriptions made by the internist, five (10%) reported they started to use this medication. Furthermore, two (2.7%) of the 75 patients that received the advice to visit a GP to discuss medication reported they visited the GP.

Discussion

Screening of CVD risk at outpatient clinics of the hospital appears both necessary as well as feasible, based on the percentages of high CVD risk (79%) among both patient groups and the positive attitude of patients towards screening. Patients from vascular surgery (secondary prevention) were more positive about the screening, which is mainly reflected by statements regarding confidence in healthcare providers and the location they are screened. Despite this positive attitude, the percentage of patients that reported lifestyle changes as a result of screening is low. In addition, prescriptions of medication to improve secondary prevention did hardly result in any adherence.

Based on the high percentage of patients at risk of CVDs that visit the hospital, it can be argued that the hospital is a good setting for CVD screening. This is also supported by the guidelines that underline the importance of screening [6,16-18]. Furthermore, when screening for CVD at the department of rheumatology (primary prevention) we found that

66.0% of the patients had a moderate to very high risk, while in the general population this percentage is lower, around 40% [19]. This is in line with increased CVD risk of RA patients [20]. This risk, which is reflected in the elevated SCORE scores, suggests that the department of rheumatology is a logical site for CVD risk screening and prevention. In addition, patients' positive attitude towards the screening suggests that the implementation was feasible, both for primary and secondary prevention. In general, patients' attitude of CVD screening is positive and this positive attitude can motivate patients towards lifestyle changes [21]. On the other hand screening of CVD can cause anxiety and confusion as well [22]. So in addition to screening and reporting on risk, it is important to realize that patients need more support such as information what exactly cardiovascular risk means and how to adapt to lifestyle changes and changes in medication [21].

The number of patients that reported behavioral lifestyle changes, is disappointingly low (24.2%). The low adaptation to lifestyle change is in line with what is known in literature [23]. This is also known for CVD prevention and secondary prevention especially. Even when it comes to more intensive interventions, adaptation to lifestyle advice is low among this population [11,24-26]. In the current study, most lifestyle changes (94.4%) were observed among patients that attended the personal motivational interviewing consult to talk in more detail about the personal prevention advice they received, and thus had a more intensive intervention. This suggests that more intensive counseling can lead to more behavioral change. Nevertheless, we must be careful with drawing conclusion about the effect of the consultation. Given the voluntary nature of the consultations, patients that accepted the invitation were probably the patients who already were motivated to make lifestyle changes. However, motivational interviewing has proved to promote lifestyle changes, but it is often not a quick fix [27]. Therefore, it is important for further research to investigate the intensity of counseling but also other strategies to improve lifestyle changes among patients at risks for CVD.

Despite that only a few patients reported having made lifestyle changes, the majority of the patients reported being more aware of their risk to get or aggravate CVD. In other words, the screening and the advice increased patients' awareness of CVD risk. This is an important first step in CVD prevention, because awareness is a prerequisite for behavioral change according to the transtheoretical model of Prochaska [28]. This is especially of importance for patients without pre-existing CVD (primary prevention), since these patients are often not aware of their risk. The current study underlines the importance of being more aware since we found a positive association between risk awareness and self-reported lifestyle changes among patients from the rheumatology department. Despite that 73.8% of the patients with established CVD were more aware of their personal CVD risk, for this group the screening and additional advice did not seem to be a trigger to make lifestyle changes. Literature shows that more knowledge about preventive actions is associated with an

improved adherence to lifestyle change and medication [29]. Despite that patients within the current study reported that they have more knowledge of actions they can take to prevent CVD, we were not able to demonstrate this association. Larger cohorts are necessary to show potential associations between patients' attitudes and actual lifestyle changes.

Remarkable is the discrepancy in patients' attitude towards screening and prevention and their behavior, especially among patients from vascular surgery. Patients screened for secondary prevention had a more positive attitude towards CVD screening, while they were less prompted to take action after screening. Patients screened at the vascular surgery department were more positively about for example the skills and knowledge of healthcare workers and the screening location. Of course, the CVD screening is in line with their regular care. Moreover, the sense of urgency might be higher as well because the onset of symptoms of CVD. Despite the more positive attitude towards screening, they reported fewer behavioral changes than patients from the rheumatology department. The majority of the latter patients was not aware of the high CVD risk, while the patients of the vascular surgery department were familiar with the disease and had received the lifestyle and medication advices more often. If these patients were very motivated to change, they might have made changes before screening. Older age (caused by selection criteria) and the presence of comorbidity within vascular surgery patients may have affected behavioral change within this group as well.

A strength of this study is that we assessed screening in a primary as well as secondary CVD prevention setting and that we implemented a screening instrument that was simple and feasible in both departments. We implemented this screening program in an academic hospital but based on the minimal requirements of personal and equipment, we expect this screening program is possible to implement in different kind of hospitals. In our study only patients who were diagnosed with RA, SA or AP were eligible, since these diagnoses are associated with a higher risk of CVD. As a result, many patients who attended the rheumatology department with other diagnoses were not eligible for screening. However, we decided to apply this inclusion criteria, as it is established that these RA patients have comparable CVD risk to patients with type two diabetes [30]. Therefore, these results may not be generalizable to all departments. Though, more factors are known for CVD risk such as Systemic Lupus Erythematosus, inflammatory bowel disease an Chronic Kidney disease [31,32]. Screening patients with these diseases might be beneficial as well. Since the focus was on implementation at the departments, the study methods like recruiting patients in the waiting room, affected available outcome measures. For example, baseline characteristics like age and gender were not requested separately from the risk estimation through the application and therefore not available outside the application. Furthermore, the lifestyle changes outcomes were self-reported, which could have led to socially desirable answers. Changes in medication are also only based on self-reported data of patients. In order to

gain better insight in compliance to medication changes self-reported data should be complemented with data from electronic patient files and pharmacists.

This study describes the first step in prevention of CVD in a hospital setting. The results of this study showed that CVD screening is feasible within the departments of rheumatology and vascular surgery. We suggest that this type of screening could also be used in other departments with potential high risk patients, such as the neurology department [31]. In addition, the high numbers of patients screened for secondary prevention that needed changes in medication is remarkable. Medication errors can include non-adherence [33], but also medication discrepancies, mostly characterized by omission of a medication [34]. An alarming problem that needs further attention. Despite the promising results, long term follow-up results are needed as well as more intensive prevention strategies to actually reduce CVD risk among these patients. Therefore, strategies to increase lifestyle and medication changes are important. Digital tools such as smartphone apps [35] and counseling strategies such as motivational interviewing could be beneficial for this patient group [36]. However, in the prevention of CVD also behavior of healthcare providers is important [37]. More research is necessary to examine behavior of healthcare providers involved in preventive screening and how they can best use strategies to improve behavioral change among patients.

Conclusion

The high percentages of patients at risk that were identified, underlines the importance of CVD screening in a hospital setting. In addition, the positive attitude of patients towards CVD screening at outpatient clinics in a hospital suggests a hospital setting is a suitable setting to implement a CVD screening program, at least from a patients' perspective. Moreover, this relatively simple form of preventive care may already lead to more awareness among patients about their CVD risk. In patients screened for primary prevention awareness is associated with self-reported lifestyle changes. However, the number of patients who translated their personal advice into actual lifestyle changes was low. More intensive preventive strategies such as motivational interviewing have the potential to lead patients towards behavioral change. However, more research is needed to investigate how these strategies can best be implemented.

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Appendix

File 1. Personal prevention advice

Personal prevention advice

Pilot screening aggravating cardiovascular disease

Name:
Patient number:
Date of birth:
Date of screening:

What does this plan say?

1. Explanation screening for risk factors
2. Your risk profile
3. What can you do?
4. General information

Explanation screening for risk factors

Recently you visited the vascular surgery outpatient clinic at the Erasmus MC. There you were screened on your risk factors for aggravating cardiovascular diseases. During this screening, risk factors for cardiovascular disease have been mapped:

- ➔ Your lifestyle: how much you exercise and whether you smoke
- ➔ Your medical history and cardiovascular disease in your first-degree family
- ➔ Your blood pressure, height and weight (BMI)
- ➔ Your cholesterol levels

These values together form a risk profile, in which changes on a recurrent cardiovascular (e.g. heart attack) within 10 years is predicted.

The screening has revealed:

[Value %]

Since you already dealing with cardiovascular problems, it is **extra** important to maintain a healthy lifestyle and to take the right medication at the right time. Within this personal prevention advice we give you tailor-made tips. We hope to help and motivate you with the personal advice. Your general practitioner will also receive a letter with the results of your screening and he or she can advise you further in this. Together you can discuss which follow-up actions are best for your situation.

Your risk profile

The following values have emerged from your screening:

		Your results	What should it be?
BMI (measured based on your height and weight:	😐 / ☺	**[value]**	**A healthy BMI is between 20 and 25**
LDL-cholesterol (the 'unhealthy' cholesterol)	😐 / ☺	**[value] mmol**	**A healthy cholesterol is below 1.8. If LDL cholesterol deviates, medication can be given.**
HDL-cholesterol Total- cholesterol Cholesterol ratio	[value]	[value]	We mention these cholesterol values for information. Your medication will be assessed based on you LDL cholesterol.
Blood pressure (upper pressure)	☺ / 😐	**[value] mmHg**	**A healthy upper pressure is below 140 mmHg**
Smoking behavior	😐 / ☺	**You [don't] smoke**	**We always advise not to smoke or to quit smoking.**
Physical activity	😐 / ☺	**You do/don't exercise for 30 minutes a day, 5 days a week**	**The advice is to exercise more than 5 days a week, more than 30 minutes a day (if possible)**

What can you do?

In this folder you can find information about things you can do yourself to no further increase your risk of cardiovascular diseases. What you can **always** do is improve your lifestyle or maintain an already healthy lifestyle. This can be done by eating or continue to eat healthy, exercise or keep exercising and not to smoke. Besides, it also is important to avoid stress and the use of alcohol and if you do use alcohol, do so in moderation. If there is (permanently) high blood pressure and/or high cholesterol, it can be recommendable to take preventive medication in addition to maintaining a healthy lifestyle. To assess your medication use, your results have been discussed with a vascular internist.

BMI (>25) 😐

Increased BMI: equal to or higher than 25 (overweight)

Overweight increases cholesterol levels and blood pressure. Overweight is caused by a combination of eating (too much) and/or exercising (too little). For support, we have included the following advice on healthy eating and exercise in your personal prevention advice. If you want support with a healthier diet from a dietician or lifestyle coach, we recommend that you contact a dietician of lifestyle coach. If you live in the region of Rotterdam, you can contact [name] dietary advice & lifestyle coaching, [phone number], [e-mail]

PHYSICAL ACTIVITY: Exercise at least **5 days a week, 30 minutes a day**, if possible. This will strengthen your bones and muscles, improves your endurance, and makes you psychologically fitter. Try to alternate sitting still with regular walking or standing. Practical tips: try not to sit for more than half an hour at a time, get off the tram 2 stops earlier and walk the last part or try to take a walk every day. Low intensity exercise is suitable if you are not fit or in a lot of pain. It has little effect on endurance and muscle strength, but it keeps the body flexible. Examples are: moving in warm water (hydrotherapy), yoga and tai chi.

HEALTHY NUTRITION: Good nutrition is important if you want to take good care of yourself. In particular, choose whole grains, legumes, vegetables, fruits, nuts and fish. Cook with fresh product (in this way you can determine how much fat, sugar and salt you use). Preferably choose to drink water, tea and coffee without sugar. Avoid taking soda and juice from the factory. Self-squeezed vegetable and/or fruit juices are fine. For more information, we recommend you to visit www.voedingscentrum.nl.

BMI (<25) ☺

Healthy BMI: below 25

Your BMI is good! The main thing is keep it that way. We recommend eating as healthy as possible and exercise as much as possible. This way you can maintain your healthy BMI and also prevent your weight from increasing in the future. A number of tips:

PHYSICAL ACTIVITY: Exercise at least **5 days a week, 30 minutes a day**, if possible. This will strengthen your bones and muscles, improves your endurance, and makes you psychologically fitter. Try to alternate sitting still with regular walking or standing. Even if sports are not possible, you can include physical activity in your daily activities. Practical tips: try not to sit for more than half an hour at a time, get off the tram 2 stops earlier and walk the last part or try to take a walk every day.

HEALTHY NUTRITION: Good nutrition is important if you want to take good care of yourself. In particular, choose whole grains, legumes, vegetables, fruits, nuts and fish. Cook with fresh product (in this way you can determine how much fat, sugar and salt you use). Preferably choose to drink water, tea and coffee without sugar. Avoid taking soda and juice from the factory. Self-squeezed vegetable and/or fruit juices are fine. For more information, we recommend you to visit www.voedingscentrum.nl.

Medication 😐

For you blood pressure or cholesterol

Your blood pressure and/or LDL cholesterol is too high.

If the blood pressure is too high for a long time, this can damage the inside of your blood vessels. If your LDL cholesterol is elevated, changes of arteriosclerosis increases. A healthy diet and exercise are important to achieve healthy blood pressure and cholesterol levels. Sometimes, this is not enough. In collaboration with the vascular internist at the Erasmus MC, your blood pressure and LDL cholesterol and the medication you are taking were examined. Based on that, the advice is:

Get medication prescription:

Your medication needs to be changed because your values are not yet at target value. Added (see last page of this folder) is a prescription with the medication as prescribed by prof. dr. [name]. With this prescription, you can collect the medication from your pharmacy. We will also inform you general practitioner of this change in medication.

Check with attending physician

Your values are abnormal, but you are alraeady being treated for this by your doctor. It is therefore recommended to have your choelsterol and blood pressure checked regurly by your doctor to see if the medication is having the desired effect.

Contact the vascular internal surgery at the Erasmus MC

Your cholesterol and/or blood vpressure are very deviant. In consultation with the vascular internist, we have asked your attending physician at the Erasmus MC or, if you do not have an attending physician here, your general practitioner to refer you to the vascular internist. Please keep a close eye on whether you wille be called up soon or otherwise contact your practitioner yourself.

Check with your general practitioner

Your values are not yet fully up to target value, but it has not been decided to prescribe medication for this. In consultation with the vascular internist, we recommend that you contact your doctor to have you regularly checked for your blood pressure and/or cholesterol. We will also send this result to your general practitioner.

Medication ☺

For your blood pressure or cholesterol

Your blood pressure and/or LDL cholesterol are good.

High blood pressure and cholesterol levels are a risk of aggravating your cardiovascular disease. Your values are good. Continue to live as healthy as possible and/or take the correct preventive medication. We recommend you to have your blood pressure and cholesterol checked regularly. This way you know whether your values remain stable or change. We will inform your general practitioner of your screening results.

Smoking 😐

You have mentioned that you smoke.

Quitting smoking is the single most important thing to lower your risk. Smoking is one of the greatest risk factors for developing or aggravating cardiovascular diseases. This applies to both men as women. Smoking cessation is always helpful, even if you have been smoking for a long time. After a year, you have a 50% reduction in the risk of a heart attack.

We recommend a course "Quit smoking" under supervision:

At the Erasmus MC we offer help with smoking cessation. You can make an appointment without obligation at the Stop Smoking Outpatient Clinic. This is individual counselling for smoking cessation. Please contact the Erasmus MC vascular surgery secretariat to make an appointment: [mail and phone number]

General information

If you have any question regarding the brochure, please contact:
[name, phone number]
[mail]

If you want more information about lifestyle changes and healthy living, see
- **www.hartenvaatgroep.nl**
- **www.hartstichting.nl**

5

What facilitates general practitioners' follow-up after in-hospital cardiovascular risk screening?

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Submitted

Abstract

Background: General practitioners have an important role in cardiovascular disease prevention. But due to barriers, such as a lack of time, implementation of preventive guidelines remains difficult. Screening patients on cardiovascular risk in an in-hospital setting, with a monitoring role by their general practitioner, could stimulate uptake of prevention among patients and healthcare providers. The aims of this study are to investigate whether general practitioners perform actions to prevent cardiovascular disease among these patients after receiving screening results from the hospital and barriers and facilitators general practitioners experience in such an approach.

Methods: The cardiovascular disease prevention program was performed at two outpatient clinics (vascular surgery and rheumatology) within a large university hospital in the Netherlands. Results and prevention advice were sent to patients as well as their general practitioner. Continuation of preventive interventions by general practitioners and barriers and facilitators were assessed by a survey. A chi-square test was performed to compare actions initiated by general practitioners between different risk categories.

Results: Of the 465 screened patients, reports were sent to the general practitioners of 444 patients. General practitioners of 155 patients responded to the survey. Of the 96 high and very high risk patients, 41 (42.7%) had contact with their general practitioner regarding the screening. Twenty-two general practitioners initiated an intervention focussing on stimulating a more active lifestyle and a healthier diet and 14 at smoking cessation and starting or changing medication. Most general practitioners had a positive attitude towards the program. However, they reported patients' ethnicity, a low number of patient contact and a low financial status of patients as barriers for providing preventive care.

Conclusion: Cardiovascular disease prevention with in-hospital cardiovascular risk screening has been positively received by general practitioners. However, they should be supported to overcome barriers and handling different patient characteristics. Educative programs as well as collaboration with other healthcare providers within and outside general practice could be beneficial in improving preventive care of cardiovascular diseases.

Introduction

Cardiovascular diseases (CVD) represent one third of all deaths worldwide. This makes it the number one cause of death with around 17.9 million deaths a year [1]. CVD can be prevented by addressing lifestyle behaviours such as physical activity, diet and smoking. For secondary prevention, and prevention for patients with a very high risk of developing CVD, treatment also requires the use of medication, such as aspirin, beta-blockers and statins. When targeted at those at high risk for CVD, multifactorial programs focussing on lifestyle behaviours have the potential to reduce the presence of risk factors in primary prevention [2,3]. For secondary prevention, interventions targeting lifestyle behaviours and medication change have shown to be effective in reducing morbidity and mortality [3].

The European CVD guideline recommends regular screening on CVD risk [4]. Due to general practitioners (GPs) central role in healthcare and their knowledge about patients' medical history they are ideally suited to provide CVD risk assessment. For European countries, the ESC describes this unique role for GPs in preventing CVD, but also in other countries GPs have an important role in providing cardiovascular risk assessment [4-6]. Even though a preventive approach by screening and addressing lifestyle factors is feasible within primary care settings, implementation of preventive interventions into practice is difficult [7,8]. Despite that most GPs indicate that selective prevention of CVD is useful and see it as part of their normal duties, patients are not actively invited for screening [9]. GPs often lack the opportunity to proactively perform cardiovascular risk management [10], thereby missing patients with a potential high risk. A lack of time, not having the confidence that their commitment will improve clinical outcomes, patient compliance and a lack of financial resources are among the reasons that CVD guidelines are not successfully implemented [11-14]. Due to these barriers the initiative to receive cardiovascular risk management is more with the patient. Therefore, not only patients with a potential high risk might be missed but it might also cause inequality in healthcare. Collaboration between GPs and other healthcare providers, such as in-hospital specialist and nursing staff could improve implementation [11,15,16]. These healthcare providers can contribute by assessing risk factors among patients and enable GPs to provide preventive care to these patients.

In-hospital clinics that are visited by a high risk CVD patient population have a great potential to start CVD prevention [17]. The department of vascular surgery is one of the departments where prevention of CVD could be useful. Furthermore, patients with rheumatoid arthritis are at high risk for CVD and screening these patients on CVD risk in the hospital is advised [18,19]. Collaboration of GPs with these in-hospital clinics could be beneficial in the prevention of CVD among high risk patients.

We performed a CVD prevention program that consisted of screening on CVD risk in two hospital settings with a high risk population (vascular surgery and rheumatology) followed by a personal prevention advice based on modifiable risk factors. The screening results and accompanying prevention advice of the in-hospital CVD screening was sent to patients as well as their GP. Afterwards a survey was sent to GPs to investigate 1) whether general practitioners perform actions to prevent CVD among these patients after receiving screening results from the hospital, and 2) which barriers and facilitators general practitioners experience with the CVD prevention program and with CVD prevention in general

Methods

Study design and study population

Within this observational study, we assessed GPs' perspectives of in-hospital CVD screening and the interventions they initiated. The GPs of patients that were screened at two different outpatient clinics of a university hospital between October 2017 and February 2018, were invited to participate in the study. Within the Erasmus Medical Center in Rotterdam, the Netherlands, two departments were selected to investigate the added value of primary (rheumatology) and secondary prevention (vascular surgery). Patients and patients GP received screening results and advice to prevent CVD. The study protocol was approved by the ethics committee of the Erasmus Medical Center, Rotterdam, the Netherlands (MEC-2017-350).

CVD prevention program

The CVD prevention program consisted of two steps. First patients were screened in the hospital for their risk of developing or aggravating CVD. Screening was performed by a research assistant using a mobile application (SCORE/SMART). The SCORE (Systematic Coronary Risk Evaluation) risk estimation was used at the rheumatology department for primary prevention. It estimated the 10 years risk of a fatal cardiovascular disease event based on the factors age, gender, smoking, systolic blood pressure and total cholesterol [20]. Because risk of rheumatology patients is comparable with risk of patients with diabetes mellitus, within the calculation patients age is increased by 15 years to give a more realistic risk calculation. The SMART (Secondary Manifestations of ARTerial disease) risk estimation was used at the vascular surgery department and estimated the risk of recurrent vascular events. Besides the factors used in the SCORE risk estimation, risk was based on the factors HDL cholesterol, glomerular filtration rate (GFR), C-reactive protein (CRP), the years since the first cardiovascular event and the type of event [21]. Patients were allocated to a three-level risk profile: 1) low-to-moderate risk (<10%), 2) high risk (10%-20%) and 3) very high risk (≥20%). In addition to factors used for the risk estimation, Body Mass Index (BMI) was measured and physical activity assessed in order to provide personal prevention advice. For

the second part of the program, regardless of risk, patients received their screening results and a personal prevention advice based on their risk factors by mail. Treatment advice was aimed at more physical activity, a healthier diet, smoking cessation and/or medication change. Low risk patients received their screening results and advice aimed at a healthy lifestyle. High risk patients received their screening results, advice and were invited for a motivational interview consult. The second step also included that patients' GPs were notified of the screening results and the personal prevention advice. Results were sent with the purpose of making them aware of the fact that their patient was screened in the hospital and that there would be a chance the patient would contact the GP about it. Similarly to inform GPs about their patients' risk of CVD to enable follow-up care where appropriate.

Outcome measurements

After receiving the screening results of patients, GPs received a survey to assess follow-up actions they undertook based on their patients' screening results (see appendix file 1). Actions were divided in different domains of interventions, namely interventions focussing on more physical activity, a healthier diet, smoking cessation, start or change medication and other interventions.

Furthermore, the survey included questions to explore barriers and facilitators GPs experience of the CVD prevention program and prevention in general (see appendix file 1). This survey was based on the Barriers and Facilitators Assessment Instrument [22] and consisted of 35 statements. Of these statements, 24 focussed on the CVD prevention program as used in the current study and 11 on providing preventive care in general. Statements could be answered with a five point Likert scale with answers ranging from 1 (totally agree) to 5 (totally disagree). Factors were defined as barriers if ≥50% of the respondents disagreed or totally disagreed with a positive statement; or ≥50% of the respondents agreed or totally agreed with a negative statement. Factors were defined as facilitators if ≥50% of the respondents agreed or totally agreed with a positive statement; or ≥50% of the respondent disagreed or totally disagreed with a negative statement. All 35 statements could be divided in five domains: 1) patient characteristics (6 statements), 2) healthcare provider characteristics (14 statements), 3) context characteristics (5 statements), 4) program characteristics (6 statements) and 5) attitudes (4 statements). Summary scores for five different domains were calculated. In order to do so, positive statements were recoded, and a summary index was calculated by dividing the sum score of domains by the number of statements in the domain. The index ranges from 1 (very possible being a barrier) to 5 (very possible being a facilitator).

Statistical analyses

To show outcomes of actions GPs undertook after receiving the screening results, frequencies (n/%) were calculated. To compare these actions taken by GPs between different

risk categories of developing or aggravating CVD among patients a chi-square test was performed. To assess which factors were considered barriers and facilitators, frequencies (n/%) for all statements were calculated of the replies (totally) agree and (totally) disagree. Summary index of domains were expressed as mean and standard deviation. To examine the differences in these domains between different risk categories among patients an ANOVA was performed, in which missing values were excluded. An independent t-test was performed to investigate the differences in domains between GPs that initiated an intervention and those who did not. Data were analysed using SPSS Statistical data software (IBM) version 25.

Results

General characteristics

In total 465 patients were screened on CVD risk. A letter with the screening results and survey was sent to the GPs of 444 of these patients. The GPs of 155 patients responded to the survey, 72 (46.5%) of these patients were screened for primary prevention (rheumatology) and 83 (53.5%) for secondary prevention (vascular surgery). More than half of these patients (51%) had a very high risk of developing or aggravating CVD, 11% a high risk and 14.2% a low-to-moderate risk. Due to missing values, risk profiles of 23.9% of the patients were unknown. Missing values were mostly seen in lab values that were necessary to calculate the risk for vascular surgery patients (secondary prevention) according the SMART risk estimation (97%) [21]. Despite the missing values, patients and their GP received the results of known values and the advice based on modifiable risk factors. When looking at modifiable risk factors within these 155 patients, 89 patients (57.4%) had an elevated BMI (≥25), 51 (32.9%) did not meet the criteria for physical activity (≥30 minutes a day, ≥5 days a week) and 36 (23.2%) smoked.

Of the 155 responses from patients GPs, 123 (79.4%) GPs indicated they had received and read the screening results of their patients of which 27 (17.4%) also indicated that the hospital proposed a medication change for patients. To discuss screening results, contact between GP and patient was realised in 52 (33.6%) cases. In 28 cases, this was initiated by the GP and in 24 cases by the patient. In 67 (43.2%) cases, there was no appointment between patient and their GP regarding the screening, of whom 26 had a very high risk of developing or aggravating CVD. GPs performed additional tests like measuring blood pressure, cholesterol and kidney function among 28 (18.1%) patients, mostly among patients with a very high risk (n=21). An overview of steps GPs took after receiving screening results can be found in figure 1.

In total 96 patients had a high or very high risk, which made actions of GPs focussing on modifiable risk factors warranted. Of these 96 patients with a high or very high risk, the report and advice were read by 75 GPs (78.1%) of which 41 patients (42.7%) had contact with their GP regarding the screening. Of the 55 patients who had no contact with the GP regarding screening, for nine a change in medication was proposed as a result of screening. Some GPs indicated that regardless of screening contact was realized, for example for other complaints or regular visits with the practice nurse (n=22, 22.9%). While after screening, 30 patients (31.3%) had no contact at all with the general practice. Some GPs commented that they expected follow-up of other healthcare providers, for example with patients who are under regular cardiovascular risk management.

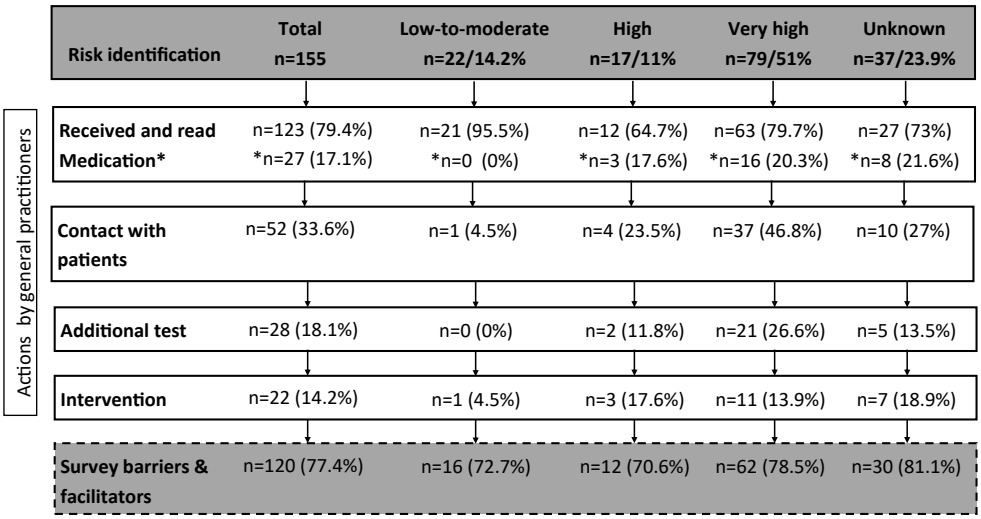

Figure 1. Flowchart of actions by general practitioners involved in the study
*Medication change proposed by the hospital

Interventions started by general practitioner

To prevent CVD, some GPs reported that they initiated an intervention: 22 GPs aimed at increasing physical activity, 22 aimed at a healthier diet, 14 aimed at smoking cessation, 14 aimed at starting or changing medication and 10 initiated another intervention. Among patients with a very high risk 11 interventions (13.9%) were initiated, among patients with a high risk 3 (17.6%) and among patients with a low to moderate risk 1 (4.5%). An overview of interventions initiated by GPs, divided by risk status of their patients, can be found in figure 2.

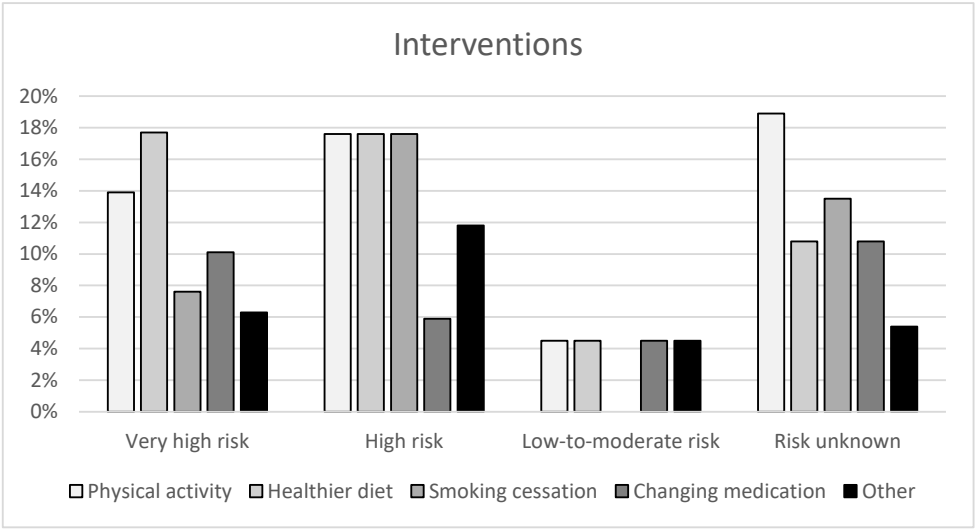

Figure 2. Interventions GPs initiated after receiving the results of the in-hospital CVD screening

Most of these interventions focus on those patients that had modifiable risk factors at the start of the program. Among the 36 patients that smoked, 11 (30.6%) GPs initiated an intervention aimed at smoking cessation. Among the 51 patients that did not meet the criteria for physical activity, 9 (17.6%) GPs initiated an intervention aimed at improving physical activity. And among the 89 patients with an elevated BMI, 13 (14.6%) GPs initiated an intervention aimed at a healthier diet and 10 (11.2%) GPs initiated an intervention aimed at improving physical activity.

Barriers and facilitators experienced by general practitioners

Of the 155 GPs that participated in the survey, 120 completed the questions regarding barriers and facilitators of the CVD prevention program and prevention in general (figure 1).

Of the 24 statements related to the CVD prevention program used in the current study, seventeen statements were indicated as a facilitator by GPs. Most GPs had a positive attitude towards the program as 63.3% found it appropriate and important and only 2.5% thought the program was meaningless and unwise. That the program leaves enough room for GPs own conclusions was most often mentioned as facilitator, 70% of the GPs agreed with this positive statement. No clear barriers for a successful implementation of the prevention program were seen among GPs. An overview of statements regarding the instrument used in the study can be found in table 1.

Table 1. Barriers and facilitators mentioned by GPs (n=120) for implementation of the current prevention instrument.

Statements current instrument	+ / -	Agree	Neutral or don't know	Disagree
Program characteristics				
Specificity, flexibility - This prevention program protocol leaves enough room for me to make my own conclusions	+	**70.0%**	21.7%	7.5%
Specificity, flexibility - This prevention program protocol leaves enough room to weigh the wishes of the patient	+	**65.0%**	29.2%	4.2%
Didactive benefit - This prevention program protocol is a good starting point for my self-study	+	41.7%	37.5%	18.3%
Attractiveness - The lay-out of this prevention program protocol makes it handy for use	+	28.3%	55.8%	10.8%
Time investment - Working to the prevention program protocol is too time consuming	-	33.3%	30.0%	35.0%
Compatibility - The prevention program protocol does not fit into my ways of working at my practice	-	5.8%	40.0%	**50.8%**
Healthcare provider characteristics				
Motivation - I am prepared to use this prevention program protocol in the future	+	**54.2%**	37.5%	5.0%
Motivation - I have used this prevention program protocol in the past	+	**57.5%**	27.5%	11.7%
Group norms, socialization - Fellow doctors (with whom I feel associated with) would use this prevention program protocol	+	48.3%	44.2%	2.5%
Motivation - I belief that if I use this prevention program protocol I can prevent cardiovascular disease	+	**60.0%**	31.7%	5.8%
Involvement - I did not thoroughly read nor remember the prevention program protocol	-	15.8%	31.7%	**50.0%**
Knowledge, motivation - I wish to know more about the prevention program protocol	-	23.3%	30.8%	40.8%
Doubts about innovation - I think parts of the prevention program protocol are incorrect	-	9.2%	34.2%	**53.3%**
Group norms, socialization - Fellow doctors (general practitioners) do not cooperate in applying the prevention program protocol	-	5.8%	35.0%	**56.7%**
Group norms, socialization - Other doctors or assistants do not cooperate in applying the prevention program protocol	-	5.0%	35.8%	**56.7%**
Group norms, socialization - Managers/directors do not cooperate in applying the prevention program protocol	-	3.3%	35.0%	**60.0%**
Working style - I have problems changing my old routines	-	10.8%	23.3%	**62.5%**
Role perception - I have a general resistance to working according to protocols	-	13.3%	30.8%	**53.3%**
Patient characteristics				
Motivation to change - Patients do not cooperate in applying the prevention program protocol	-	17.5%	45.8%	34.2%
Context characteristics				
Reimbursement - Working according to this prevention program protocol requires financial compensation	-	38.3%	37.5%	20.8%
Attitudes				
I think this prevention program protocol is appropriate	+	**63.3%**	25.8%	3.3%
I think this prevention program protocol is important	+	**63.3%**	28.3%	0.8%
I think this prevention program protocol is meaningless	-	2.5%	21.7%	**68.3%**
I think this prevention program protocol is unwise	-	2.5%	22.5%	**65.0%**

+ = positive statement, - = negative statement. All statements within this table reflect on the prevention program as used in the current study. Bolt numbers are above the 50% and therefore a barrier or facilitator. Italics is used to highlight the topic of the statement.

Of the eleven statements related to preventive care in general, five were seen as facilitators. GPs considered context characteristics such as the opening hours of the practice (69.2%), facilities available (68.3%) and the practice building (62.5%) as facilitator for implementing preventive programs. Furthermore, healthcare provider characteristics such as their own involvement (66.7%, but mainly their education as preventive care giver (81.7%) were seen as facilitator for providing preventive care. However, three barriers for implementing preventive interventions were found as well. Results showed that patients related determinants such as patient's ethnicity (62.5%), how often patients visit the practice (60.2%) and patients financial status (54.2%) were identified as barriers. An overview of all statements regarding prevention in general can be found in table 2.

Table 2. Barriers and facilitators mentioned by GPs (n=120) for implementation of preventive care in general.

Statements prevention in general	+ / -	Agree	Neutral or don't know	Disagree
Healthcare provider characteristics				
Education - It is difficult to give preventive care because I am not trained in giving preventive care	-	3.3%	15.0%	**81.7%**
Involvement - It is difficult to give preventive care because I have not been involved in setting up the preventive care	-	13.3%	19.2%	**66.7%**
Context characteristics				
Supportive staff - It is difficult to give preventive care if there is not enough supportive staff	-	37.5%	13.3%	48.3%
Facilities - It is difficult to give preventive care if instruments needed are not available	-	11.7%	20.0%	**68.3%**
Practice building - It is difficult to give preventive care if physical space is lacking (e.g. consulting room)	-	26.7%	10.8%	**62.5%**
Opening hours of practice - It is difficult to give preventive care because the timing of the preventative care is awkward	-	11.7%	19.2%	**69.2%**
Patient characteristics				
Ethnicity - It is difficult to give preventive care to patients with a different cultural background	-	**62.5%**	21.7%	15.8%
Health status - It is difficult to give preventive care to patient who seem healthy	-	36.7%	22.5%	40.8%
Financial situation - It is difficult to give preventive care to patients with a low socio-economic status	-	**54.2%**	20.0%	25.8%
Age - It is difficult to give preventive care to older patients (60+)	-	15.8%	35.0%	49.2%
Number of patient contacts - It is difficult to give preventive care to patients rarely visiting the practice	-	**60.8%**	17.5%	21.7%

+ = positive statement, - = negative statement. All statements within this table reflect on prevention in general. Bolt numbers are above the 50% and therefore a barrier or facilitator. Italics is used to highlight the topic of the statement.

For every domain (patient characteristics, healthcare provider characteristics, context characteristics, program characteristics and attitudes) a summary score was calculated. The attitude domain had the highest summary score (mean: 3.90, SD: 0.68, 95%CI 3.77-4.04) and is therefore the domain that is most possibly a facilitator for the CVD prevention program. The patient characteristics domain had the lowest summary score (mean: 2.87, SD: 0.55, 95%CI 2.76-2.98) and therefore the domain that is most possibly a barrier for the CVD prevention program. No differences were seen between the summary scores of characteristics when comparing GPs of patients that had a low-to-moderate, high or very high risk. However, differences in summary score were seen between GPs that initiated an intervention and GPs who did not initiated an intervention. Within the healthcare provider domain GPs who initiated an intervention (mean: 3.81, SD: 0.58) had a higher summary score compared to GPs who did not initiate an intervention (mean: 3.54, SD: 0.44) (t(105) 2,691, p=0.008).

Discussion

The majority of the GPs in this study indicated having received the screening results of their patients and overall reported a positive attitude towards the CVD prevention program with initial screening patients in the hospital. In particular attitudes of GPs towards the CVD prevention program were reported as facilitator. However, patients' characteristics were reported as barrier when it comes to preventive care in general. This is seen in specific statements that were mentioned as barriers by GPs, namely their patients' ethnicity, their patients' financial status and the number of patient contacts. Despite the positive attitude of GPs towards preventive care and that they feel knowledgeable enough to provide it, among patients with a high or very high risk, only some initiated an intervention to reduce this risk.

With this CVD prevention program, screening was performed during patients' regular visit to the in-hospital clinics. The responsibility of GPs was not on initial screening, but on monitoring and when necessary providing preventive care. GPs had a positive attitude towards this CVD prevention program. They did not experience barriers regarding the program such as "too time consuming" and "providing preventive care requires a financial contribution", which were found in other studies on CVD prevention [11,12]. Furthermore, making their own conclusions was an important facilitator for implementation, something GPs prefer over following specific guidelines for screening [11].

Although this approach might have initiated a more positive attitude and eliminated some barriers among GPs, it also exposed some pitfalls. One of those is the transfer from care within the hospital to general practice. This transfer remains difficult and a point of

attention, since it can reduce continuity of care and therewith the quality of patient care [23,24]. A better continuity of care is necessary to make a real difference for the patient. This not only concerns the step after risk identification, which is an important first step in an approach to prevent CVD [25], but also follow-up in providing care that reduces CVD risk. In the current study, the transfer of information from hospital to GP care went well, 79.4% of GPs indicated receiving and reading the results of the hospital screening. Nevertheless, the transfer of care, which also involves the uptake of care, can be improved. Of the very high risk and high risk patients respectively less than half and even less than a quarter of the patients had an appointment with their GP regarding the results of the in-hospital screening. Among patients with low-to-moderate risk this was even lower. Despite that this care seems less crucial, it is a missed chance to address risk factors among patients with moderate risk. Besides, the actual risk is not always in line with patient concerns about it. Therefore, no matter the risk of CVD it is important to properly communicate about it to the patient [26]. It is likely that the cardiologist can guidance patients towards prevention. He or she is expected to have the knowledge and skills to manage lifestyle changes and work together with other healthcare providers to provide continuity of CVD prevention [27]. However, this also highlights another concern, namely providing preventive care focussing on lifestyle modification. It is uncertain if cardiologist, but also GPs and non-cardiology healthcare professionals possess the knowledge to provide especially secondary prevention [28]. This is also seen among GPs in the current study. When there has been an appointment, providing preventive care by lifestyle modification is often missing or minimal. Despite that guidelines describe a role for GPs in providing preventive care and in stimulating patients to a healthy lifestyle it is not guaranteed that these actions will be performed. Other studies point out that GPs experience problems with explaining potential risk and motivating patients to behavioural change [15,26,29].

The question remains, who is responsible for CVD prevention. GPs have a central role [5], which is indicated by GPs themselves as well [30]. In which they mainly focus on secondary prevention [31]. Nevertheless, primary prevention ensures a greater reduction in disability and deaths [32]. Because of the focus and the pro-active role that is expected from patients themselves, we see that patients at risk of CVD will not always receive optimal care. This because they are not aware of their risk or are maybe too modest to ask. In addition, GPs indicate not always having the time, knowledge and ability to provide the care patients need, such as communicating about CVD risk and providing support in lifestyle change [15,26]. Dividing tasks and collaborations can help GPs and other healthcare providers in providing the care necessary to reduce CVD risk among their patients [28]. In line with the screening, specialist within the hospital could highlight the importance of lifestyle changes as smoking cessation and physical activity. However, within the hospital, also other preventive care interventions can be promoted. For example a smoking cessation clinic [33] and more active counselling on physical activity can also have positive health outcomes [34]. Besides

the specialist, a nurse led intervention, has proved effective in reducing CVD risk [35]. In addition, patients describe the support by nurses as positive and do not see it as interfering in their lives [36]. In some cases, follow-up might be possible within the general practice itself. Supporting staff, practice nurses or staff trained in providing preventive care could contribute to CVD prevention [30,37]. Quality of a well-trained nurse does not seem inferior to that of a GP [38]. Moreover, practice nurses even adhere better to prevention guidelines and more often provide lifestyle advice compared to GPs [39]. However, to stimulate more proactive preventive care in which practice nurses can facilitate, funding to initiate this proactive approach is necessary. Despite that funding differs per country, GPs from several European countries mention financial opportunities as suggestion for improving preventive care [9,11]. In addition, collaboration with other healthcare providers in a team-based approach seems beneficial for CVD preventive care [30,40,41]. For example, the help of a dietician for stimulating patients to a healthy diet can help GPs in providing preventive care [41]. With a contribution of multiple healthcare providers prevention could be more than telling patients 'to be more active' or 'to quit smoking' and GPs can focus on the more high-risk cases. However, when dividing tasks between healthcare professionals, clear distinction between tasks is necessary in order to avoid overlap but also to not lose sight of patients. Both cases were highlighted by GPs in the current study. Some GPs already screened their patients on cardiovascular risk, making the current screening unnecessary while others found the screening helpful in directing them to the patients that are at risk. Therefore, more research is needed to design an approach to overcome this overlap and to find out which patients are missed with the current guidelines.

Strengths and limitations

The CVD prevention program with in-hospital screening is an approach that can potentially greatly benefit the prevention of CVD but has not been investigated substantially. The impact of multiple healthcare professionals initiating an intervention or asking about CVD risk, can make a greater impression on patients. Something which is seen in smoking cessation, wherein adherence increases when patients are addressed on their smoking behaviour by more than one healthcare provider [42]. Screening within the hospital and follow-up by their GP can potentially increase patient adherence to lifestyle advice. Despite this potential of in-hospital screening, GPs have an important role in providing CVD prevention after screening. A strength of this study is that it focusses on this important group of healthcare professionals in the prevention of CVD. However, the results of initiated interventions within this study only relate to GPs own reports. We described patients' adherence to advice in another study but unfortunately were not able to connect patients answers to those of GPs, due to a significant time difference between both surveys. Furthermore, reasoning for not consulting the patient are largely unknown, but could be rational. Some GPs reported that they expected the specialist to do so while others pointed out the cardiovascular risk management program some patients already participated in. Furthermore, there was a

large group whose risk was unknown. Nevertheless, within this group, many preventive actions were initiated by GPs, mainly to increase physical activity. Lastly, this study design can also have led to selection bias, as no emphasis was placed on specific tasks for GPs. We found that most GPs received and read the screening results. However, this is only among GPs that responded to our survey. We have no information regarding non-responders, but it could be that these GPs did not receive any results or did not read them, initiated fewer interventions or were less motivated to provide preventive care at all and for that reason did not respond. In addition, of the GPs that responded, we did not collect baseline characteristics. Therefore, we do not know whether it is a representative group and whether results can be generalized.

With this study, promising steps for the uptake of CVD prevention were performed. With this approach of screening patients for their CVD risk within the hospital, the difficult step for GPs to initiate preventive care and not waiting on patients' initiatives is taken care of. In this way, more patients with high risk are brought to the attention of the GP. Besides, the CVD prevention program has been positively received by most GPs. However, as discussed, it also exposed many challenges for which we do not yet have a fitting solution. Therefore, it is important to further investigate these challenges before implementing such an approach. One of these challenges in the important step from the identification of risk to providing preventive care by GPs. It is essential to find out what GPs need in providing this care within general practice. They specify that most important barriers are external [43]. This study adds that these external factors are mainly within patients' characteristics. We found that GPs find it difficult to provide preventive care to patients with a different cultural background, a low socio-economic status and to those that rarely visit the GP. For further implementation, these barriers need more attention. Educational programs focussing on these patient characteristics, but also on how to communicate risk and support lifestyle changes can be helpful since these are common barriers among GPs but also other healthcare providers [28,44]. Furthermore, support from other healthcare professionals could be beneficial, but it is not yet clear how this should be designed. More research is needed to who can collaborate with the GP and what specific tasks should be. Responsibility of the same tasks have to be avoided while ensuring continuity of care. A complex challenge in which technical interventions could facilitate as well [37].

Conclusion

Despite a positive attitude of GPs towards the CVD prevention program that screened patients on CVD risk within the hospital, even for patients with a high or very high risk only some GPs initiated an intervention to reduce this risk. Well-known problems among GPs, such as properly informing patients about their risk and giving lifestyle advice, need more

attention. Educational programs that also focus on different patient characteristics could help GPs in improving their preventive care. Besides, some tasks might be better transferred to other healthcare professionals inside and outside the general practice. However, designing such an approach needs more attention in order not to harm the continuity in care and to overcome overlap in providing care.

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Appendix

File 1. Survey general practitioners

Survey application of and experience with pilot cardiovascular disease

1. What is your role in general practice?

- ☐ General practitioner
- ☐ Practice assistant
- ☐ Other: ……

2. Did you receive/read the results of the screening for cardiovascular risk from the patients described in the attached letter?

- ☐ Yes, received and read
- ☐ Received, not read
- ☐ No, not received
- ☐ Unknown

3. Have you been in contact with this patient about the screening results since you received the results?

- ☐ Yes, practice has contacted the patient
- ☐ Yes, the patient initiated contact
- ☐ No, there has been no contact with the patient
- ☐ Other: ……
- ☐ Unknown

4. Have you performed additional diagnostics on this patient in a response on the screening results?

- ☐ Yes. Which? ……
- ☐ No
- ☐ Unknown

5. Since receiving the screening results, have you initiated any intervention(s) that aimed to prevent cardiovascular disease in this patient?

In the table below, enter per domain whether you decided not to initiate an intervention, had a wait-and-see policy or initiated an intervention. And if so, what type of intervention?

Domain	Action
Increase physical activity	☐ No intervention ☐ Wait-and-see policy ☐ Initiated intervention: ……
Healthier diet	☐ No intervention ☐ Wait-and-see policy ☐ Initiated intervention: ……
Smoking cessation	☐ No intervention ☐ Wait-and-see policy ☐ Initiated intervention: ……
Start/change medication	☐ No intervention ☐ Wait-and-see policy ☐ Initiated intervention: ……
Other: ……	☐ No intervention ☐ Wait-and-see policy ☐ Initiated intervention: ……

Explanation:

By 'this prevention program protocol' is meant the guideline cardiovascular risk management implemented in this pilot, which includes:

- → Screening for risk factors for cardiovascular disease at the outpatient clinic;
- → Screening results for patient, outpatient clinic and general practitioner;
- → Preventive consultation by a consultant at the outpatient clinic for patients with a high risk and modifiable risk factors.

Please indicate to what extent you agree with the following statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
This prevention program protocol leaves enough room for me to make my own conclusions	○	○	○	○	○	○
This prevention program protocol leaves enough room to weigh the wishes of the patient	○	○	○	○	○	○
This prevention program protocol is a good starting point for my self-study	○	○	○	○	○	○
I did not thoroughly read nor remember the prevention program protocol	○	○	○	○	○	○
I wish to know more about the prevention program protocol	○	○	○	○	○	○
I have problems changing my old routines	○	○	○	○	○	○
I think parts of the prevention program protocol are incorrect	○	○	○	○	○	○
I have a general resistance to working according to protocols	○	○	○	○	○	○
Fellow doctors (general practitioners) do not cooperate in applying the prevention program protocol	○	○	○	○	○	○
Other doctors or assistants do not cooperate in applying the prevention program protocol	○	○	○	○	○	○
Managers/directors do not cooperate in applying the prevention program protocol	○	○	○	○	○	○
Patients do not cooperate in applying the prevention program protocol	○	○	○	○	○	○
Working to the prevention program protocol is too time consuming	○	○	○	○	○	○
The prevention program protocol does not fit into my ways of working at my practice	○	○	○	○	○	○
Working according to this prevention program protocol requires financial compensation	○	○	○	○	○	○
The lay-out of this prevention program protocol makes it handy for use	○	○	○	○	○	○
I am prepared to use this prevention program protocol in the future	○	○	○	○	○	○
I have used this prevention program protocol in the past	○	○	○	○	○	○
Fellow doctors (with whom I feel associated with) would use this prevention program protocol	○	○	○	○	○	○
I belief that if I use this prevention program protocol I can prevent cardiovascular disease	○	○	○	○	○	○
It is difficult to give preventive care...						
If there is not enough supportive staff	○	○	○	○	○	○
If instruments needed are not available	○	○	○	○	○	○
Because timing of preventive care is awkward	○	○	○	○	○	○
If physical space is lacking (e.g. consulting room)	○	○	○	○	○	○
Because I am not trained in giving preventive care	○	○	○	○	○	○
Because I have not been involved in setting up the preventive care	○	○	○	○	○	○
It is difficult to give preventive care to...						
Patients with a different cultural background	○	○	○	○	○	○
Patients who seem healthy	○	○	○	○	○	○
Patients with a low socio-economic status	○	○	○	○	○	○
Older patients (60+)	○	○	○	○	○	○
Patients rarely visiting the practice	○	○	○	○	○	○
I think this prevention program protocol is						
Meaningless	○	○	○	○	○	○
Appropriate	○	○	○	○	○	○
Unwise	○	○	○	○	○	○
Important	○	○	○	○	○	○

Part II

Prevention in a community setting

6

Evaluation of implementing a home-based fall prevention program among community-dwelling older adults

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Abstract

We aimed to describe and evaluate the implementation of a home-based exercise program among community-dwelling adults aged ≥65 years. In an observational study, the twelve-week program was implemented in a community setting. The implementation plan consisted of dialogues with healthcare professionals and older adults, development of an implementation protocol, recruitment of participants, program implementation, and implementation evaluation. The dialogues consisted of a Delphi survey among healthcare professionals, and of individual and group meetings among older adults. The implementation of the program was evaluated using the framework model RE-AIM. In the dialogues with healthcare professionals and older adults, it was found that negative consequences of a fall and positive effects of preventing a fall should be emphasized to older adults, in order to get them engaged in fall prevention activities. A total of 450 older adults enrolled in the study, of which 238 started the program. The process evaluation showed that the majority of older adults were recruited by a community nurse. Also, a good collaboration between the research team and the local primary healthcare providers was accomplished, which was important in the recruitment. Future fall prevention studies may use this information in order to translate an intervention in a research project into a community-based program.

Introduction

Fall-related injuries among older adults are recognized as a large burden to Western society [1], which is expected to increase, due to the ageing population. If the yearly increase of fall-related emergency department (ED) visits in the United States remains the same until 2030, the number of visits is expected to increase by 137%, to 5.7 million [2]. These increasing ED visits have a major impact on healthcare costs [3]. The impact of falls does not relate only to ED visits, but also to minor injuries treated at a general practitioner. Furthermore, falls have a large impact on the lives of older adults, as it can result in functional decline and loss of autonomy [4]. Many fall prevention programs have proven to be effective in reducing falls among older adults [5–9]. This mainly concerns multifactorial programs, which include an exercise component [5–9]. Furthermore, single exercise interventions have been proven to be effective in a community setting [7]. Effective group-based exercise programs are often offered on location, whereas older adults seem to favor individual-based programs offered in their homes [10]. This preference could be explained by the fact that group-based programs are generally more expensive, with less good accessibility [11]. Despite the existence of evidence-based programs, the successful implementation of fall prevention in the community remains a complex challenge [12]. There are only few studies that have evaluated the implementation of a fall prevention program. The majority of papers have focused on implementing fall prevention in a clinical setting [13–16]. Other studies have focused on the implementation of group-based exercise programs in the community [17–19]. To our knowledge, no study has evaluated the implementation of a home-based exercise program in the community. A review that evaluated five meta-analyses showed that effective implementation of a prevention program is strongly associated with better health-related outcomes [20]. Thus, evaluation of our implementation program could be helpful for effectively translating an intervention in a research project into successful community-based programs. The comprehensive evaluation framework model RE-AIM has been often used to evaluate implementation studies [21]. This model consists of five dimensions: reach, effectiveness, adoption, implementation, and maintenance. The aim of this paper was to describe and evaluate the implementation of a home-based exercise program in a community setting, among adults aged ≥65 years. Except for effectiveness, this paper describes the measures relating to the RE-AIM model.

Materials and methods

Study design and population

In the current observational study, a home-based exercise program was offered for twelve weeks to community-dwelling adults aged ≥65 years, living in the city of Breda, in the Netherlands. Older adults that did not understand the Dutch language, those with dementia,

or those living in a residential care facility, were excluded. The implementation of the home-based exercise program consisted of multiple steps, which will subsequently be discussed (figure 1). Written informed consent was provided by all participants. The medical ethics committee of Erasmus MC, University Medical Center Rotterdam, waived ethical approval of the study (number 2017-139).

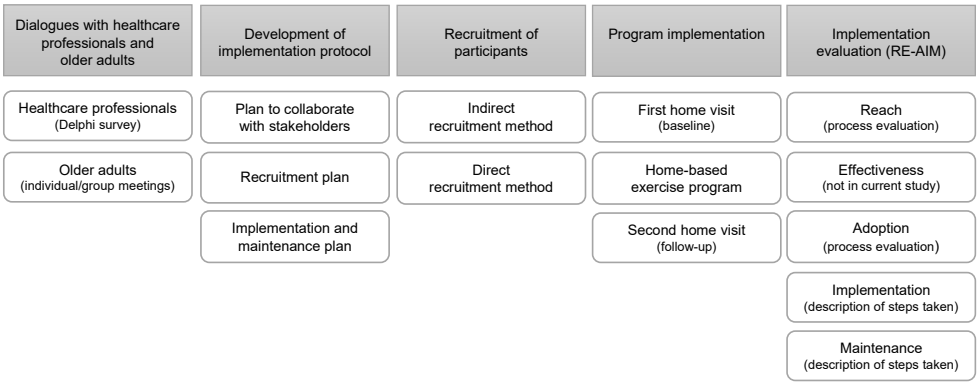

Figure 1. Steps taken to implement a home-based exercise program.

Dialogues with healthcare professionals and older adults

Prior to the implementation phase, dialogues with healthcare professionals and older adults were performed. The aim of the dialogues was to develop strategies to implement a fall prevention program in a community setting, taking into account the local needs and infrastructure. These strategies were determined based on a Delphi survey that was performed among a panel of healthcare professionals and based on individual and group meetings that were organized among a user panel of older adults. The measures of this twofold approach were used to develop the implementation protocol.

Healthcare professionals

A panel of healthcare professionals was consulted in a Delphi survey, consisting of two rounds of online questionnaires. This study was based on a previously published Delphi study [22]; however, questions were adjusted to the local settings of Breda and to the program that would be implemented. The Delphi panel consisted of community nurses, physiotherapists, occupational therapists, general practitioners (GPs), and geriatricians, from all over the Netherlands. The healthcare professionals were recruited through purposive expert sampling, in which the research groups' personal network, the network of healthcare professionals, and websites on fall prevention were used. After the first questionnaire was completed by the panel, responses were summarised in order to develop a second questionnaire. This made it possible to elaborate on all topics. The questionnaires consisted of multiple choice and ranking questions. In the current manuscript, multiple choice data

is reported as number and percentage, whereas data on ranking is reported as rank (i.e., 'most' (1) to 'least' (5 or 6)) and percentage. The level of consensus among the panel was considered as a frequency of ≥75% on multiple choice or ranking questions. The answers of healthcare professionals that completed the second round questionnaire were included in the data analysis, and are discussed in this manuscript. The online questionnaires were conducted using open-source LimeSurvey software [23]. Analyses were performed using SPSS Statistical Data software (IBM), version 24 (BO: International Business Machines Corporation (IBM), New York, United States).

Older adults

A user panel of community-dwelling adults aged ≥65 years, living in Breda, was consulted in individual and group meetings. The user panel was recruited by local community nurses. Initially, all members of the user panel were asked to participate in a group meeting. However, as some individuals had trouble walking, those individuals were visited at home, by a member of the research team. The group meetings took place in community centers, located near the homes of the older adults, and were led by a member of the research team. Another member of the research team was present to take notes during the group meetings. The questions of the individual and group meetings were drafted together with another panel of older adults, in a participatory design approach. This user panel consisted of older adults that were part of an 'older adult forum', which aims to improve the quality of life and care of older adults. The topics that were discussed during the individual and group meetings were about the barriers and facilitators for participating in fall prevention activities, and about the individuals considered key in fall prevention. The notes that were taken during the meetings by a member of the research team were used to identify and cluster specific themes. These themes were summarized, which are reported descriptively in the current paper.

Development of implementation protocol

The implementation protocol consisted of multiple topics such as a plan on the structural collaboration with stakeholders and a recruitment plan to determine which methods should be used to recruit the study population. Furthermore, a plan for practical implementation and maintenance of the program was included, which consisted of the steps taken to embed tasks concerning the implementation of the program in local organizations. During the study period, the protocol was revised and adjusted when necessary.

Recruitment of participants

The recruitment of participants consisted of indirect and direct methods. Indirectly, older adults were recruited for the study by a press release, advertisements in local papers, and commercials broadcasted on a local television and radio channel. Word of mouth resulted in older adults being recruited, as well. Directly, older adults were recruited with a personal approach by primary healthcare providers, such as community nurses, physiotherapists,

occupational therapists, and GPs. Also, information sessions and workshops for older adults were held by the research team in community centers, and flyers about the study were distributed at senior living apartments and in shopping malls. As reported previously, older adults with dementia were excluded from participating. All primary healthcare providers that were involved in the recruitment of older adults were informed about this exclusion criteria. By informing these stakeholders, an attempt was made to minimize the chances of an older adult with dementia enrolling. In the current paper, a distinction is made between older adults that 'enrolled' and 'participated' in the study. The number of older adults that 'enrolled' in the study corresponds to the number of applications that were received by the research team by telephone, regular mail, or email. The number of older adults that 'participated' in the study corresponds to the number of individuals that started the twelve-week home-based exercise program.

Program implementation

All participants were offered a home-based exercise program, which was based on the Senior Step intervention [24]. In the Senior Step intervention, participants performed self-tests for assessing mobility and fall risk. The safety and feasibility of these tests were evaluated in that study. Apart from the self-tests, participants were also offered an instruction book with exercises. The instruction book was developed by two physiotherapists, and was based on the Otago program [25]. The book consists of exercises to: (1) promote safe use of walking aids, (2) improve mobility (e.g., standing up from a chair), (3) improve reaching (i.e., forwards, sideways, and backwards), (4) improve quality of walking and walking speed, and (5) improve overall fitness (i.e., agility, strength, balance, and conditioning). The book is divided into four levels, ranging from simple, low intensive to complex, intensive exercises. In the current study, the instruction book of the Senior Step intervention was offered to participants as a home-based exercise program, for twelve weeks. During a first home visit at baseline, a member of the research team offered and explained the instruction book to the participant. The participant was advised by the research team on the exercise 'level' to start with, based on their mobility. Though, during the study period, the participant could themselves change the type and duration of exercises. During the first home visit at baseline, an 'assessing care of vulnerable elders' (ACOVE) questionnaire was given to the participant. This questionnaire evaluated the provided healthcare after a fall, in the previous 12 months [26]. It was used to create a baseline situation of the local fall-related healthcare. After twelve weeks of follow-up, a second home visit with a member of the research team took place. During this home visit, the instruction book was returned to the research team and the exercise program was evaluated with the participant by a questionnaire.

Implementation evaluation

In order to describe and evaluate the implementation of the home-based exercise program, the comprehensive framework model RE-AIM was used. This model consists of the

dimensions of reach, effectiveness, adoption, implementation, and maintenance [21]. In general, by evaluating the different dimensions within a study, information regarding the translation of research to practice is gained [21]. The original RE-AIM dimension definitions and the definitions used in the current study are presented in table 1. The dimension 'reach' was assessed through process evaluation, as the proportion of older adults enrolled in the study through indirect and direct methods. This information was gathered by asking every older adult that enrolled in the study how they were recruited. The barriers and facilitators in recruiting participants were also described for this dimension. The dimension 'effectiveness' is not discussed, as it was not the focus of the current paper. More information about the effectiveness of the program can be found in an earlier paper about the study [27]. The main findings of that paper were that 52% of the participants indicated that they frequently took part, which means that the exercises given in the instruction book were performed daily or a few days per week during the study period. Furthermore, the analyses indicated that a higher degree of pain was associated with frequent participation; however, frequent participation resulted in better health perceptions, over time. The activities that were executed to optimize collaboration between the research team and different local stakeholders were described within the dimension 'adoption'. 'Implementation' was assessed through a process evaluation, as it was defined by the extent to which the twelve-week program was realized as planned. Also, program satisfaction of the participants was reported. As described in the previous paragraph, this information was based on a questionnaire that was administered after twelve weeks of follow-up. Questions included how much the participants liked the program; how useful they evaluated it to be; and whether the participants noticed a change in their risk awareness, confidence in balance, and in their level of physical activity during the study period. The number (n) and percentage (%) are reported for these measures, and the analyses were performed using SPSS Statistical Data software (IBM), version 24. Lastly, in order to evaluate the maintenance of the program, a description was given of the steps taken to embed the tasks concerning the implementation of the program in local organizations.

Table 1. Original definitions of RE-AIM dimensions: reach, adoption, implementation, and maintenance [21], and definitions of current study.

Dimension	Original definition	Study definition
Reach	Proportion of individuals that participated in the program	Proportion of individuals that enrolled in the study through indirect and direct methods; barriers and facilitators in recruitment
Effectiveness	Outcome effects of implementing the program as planned	Not discussed in current manuscript
Adoption	Proportion of practices and individuals that adopted the program	Activities executed to optimize collaboration with stakeholders
Implementation	Extent to which the program is implemented as planned	Extent to which the program was implemented as planned; program satisfaction of the participants
Maintenance	Extent to which a program is maintained over time	Activities executed to maintain the program locally

Results

The implementation plan components 'dialogues with healthcare professionals and older adults', 'program implementation', and 'implementation evaluation' will subsequently be discussed in the results section (figure 1).

Dialogues with healthcare professionals and older adults

Healthcare professionals

A total of 129 healthcare professionals participated in the Delphi survey. The first questionnaire was completed by 81% (*n* = 105/129) of the panel, whereas the second questionnaires was completed by 74% (*n* = 95/129). According to the panel, the most important barrier in organizing fall prevention in a community setting is reaching older adults that are not in touch with healthcare professionals (*n* = 55/95; 58%) (table 2). Poor communication between different stakeholders (*n* = 50/95; 53%) and absence of a coordinator (*n* = 49/95; 52%) were mentioned as barriers, as well. Important facilitators in organizing fall prevention in a community setting are good cooperation between different healthcare professionals (*n* = 57/95; 60%) and taking into account the wishes and needs of older adults (*n* = 57/95; 60%) (table 2). The panel was also asked which individuals were considered key in organizing fall prevention in a community setting. A neighborhood care team (*n* = 26/95; 27%), the physiotherapist (*n* = 23/95; 24%), and the community nurse (*n* = 22/95; 23%) were most mentioned. A perceived barrier for participating in a fall prevention program was that older adults are not aware of the possibilities in their neighborhood (*n* = 32/93; 34% (rank 1)). Consensus was reached on facilitators to increase participation. Namely, emphasizing to

older adults that fall prevention is important in maintaining functional independence was mentioned by 77% of the panel (*n* = 72/94; (rank 1)). Furthermore, an effective measure to increase participation rates among older adults is to raise awareness on the consequences of a fall (*n* = 43/94; 46% (rank 1)). Both the GP (*n* = 32/94; 34% (rank 1)) and the informal caregiver (*n* = 28/94; 30% (rank 1)) were considered key individuals in stimulating participation among older adults.

Table 2. Barriers and facilitators according to healthcare professionals in organizing fall prevention in a community setting.

	(*n* = 95)
Barrier	(%)
Reaching older adults that are not in touch with healthcare professionals	58
Poor communication between different stakeholders	53
Absence of a neighborhood coordinator	52
Healthcare professionals that do not have enough knowledge on fall prevention	47
High costs	36
Lack of time	31
Lack of a central location in a large neighborhood	15
Facilitator	(%)
Good cooperation between different healthcare professionals	60
Taking into account the wishes and needs of older adults	60
Clear communication between different stakeholders	48
Shared vision on fall prevention in a community setting among stakeholders	42
Word of mouth	31
Providing good information about fall prevention to healthcare professionals	28
Neighborhood coordinator that takes control	21

Older adults

In total, three individual and four group meetings with user panel members took place among a total of 27 older adults living in Breda. Three individual meetings took place in the homes of older adults, whereas four group meetings took place in community centers among 24 older adults. In every group meeting, four to eight older adults were present. Several barriers of participating in fall prevention activities were identified by the older adults during these meetings. Chronic pain, fear of participating, program costs, poor accessibility, and unawareness of their own fall risk were most often mentioned. Increasing awareness of the personal relevance of fall prevention was identified as an important facilitator. The user panel mentioned that their awareness increased after they had fallen. In order to raise awareness and increase participation rates among other older adults, the panel suggested emphasis on the negative consequences of a fall. Also, the positive effects of preventing a fall, such as maintaining functional independence, should be stressed upon. Furthermore, according to the user panel members, it was considered important to offer advice (and not

frighten) to older adults concerning fall prevention activities. This way, they can make a deliberate choice without feeling forced to do so. Another strategy considered effective in engaging older adults in fall prevention activities is by involving a trusted individual, such as the community nurse, informal caregiver, or neighbor. Such an individual was thought to be different for every older adult but was perceived to be of help in stimulating participation.

Program implementation

A total of 450 older adults enrolled in the study, of which 238 older adults started the twelve-week home-based exercise program. Additional information on the baseline characteristics of older adults that enrolled the study, but did not participate, is provided in appendix table 1. At baseline, 52% (*n* = 124/238) of the participants were reported to have had a fall in the past twelve months. Out of these participants, 59 participants reported that they had visited a GP or an Emergency Department following the fall. In 12% of these 59 participants, an eye exam was performed, 15% was given a memory test, 25% was given a balance test, 22% was given advice about safety in and around the house, and 22% of the participants was advised by their physicians to start an exercise program. These results show that a limited number of participants were offered specific care to prevent a subsequent fall, prior to the implementation of the exercise program in their community.

Implementation evaluation

Reach

Indirect and direct methods

The indirect recruitment methods potentially reached 122,000 older adults. The majority of these older adults (*n* = 70,000) were reached through press releases about the study. Directly, over 3100 older adults were potentially reached. Recruitment through a community nurse (*n* = 1220) and through flyers about the study (*n* = 1000) resulted in the majority of these older adults being reached. As reported in the methods section, every older adult that enrolled in the study was asked how they were recruited. A total of 450 older adults enrolled in the study, of which 290 indicated the method of their recruitment. Twelve older adults indicated to have been recruited through an indirect method and 278 older adults through a direct method. Of the individuals recruited through a direct method, the majority (*n* = 233) were recruited through a community nurse.

Barriers and facilitators

Firstly, a barrier in recruiting participants was that, although several older adults were contacted, relatively few enrolled in the study. Indirect methods, particularly, resulted in a small number of older adults being enrolled in the study. Secondly, even though many local GPs were asked to be involved in the recruitment of study participants, not many were active in doing so. An exception being that by contacting practice nurses with specialization in care for older adults, it was possible to involve a few local GPs in the recruitment of

study participants. Third, collaboration with the local government was difficult. Reasons for the local government not being involved in the study was because fall prevention was not high on their agenda, and there also was a lack of budget. One recruitment method was identified as a facilitator in recruiting participants—personal approach by a community nurse encouraged older adults to engage in fall prevention activities, which resulted in the majority of enrolments. Another identified facilitator was the huge support for implementation of the program by local, primary healthcare providers. Optimizing a collaboration between the research team and these healthcare professionals was important in reaching and recruiting older adults.

Adoption

Several activities were executed to optimize collaboration between the research team and local stakeholders and facilitate adoption of the program. At the start of the study, neighborhood profiles were developed, which consisted of information on age distribution and socio-economic status of the inhabitants, and of a list of stakeholders we could potentially collaborate with. Then, a network with relevant stakeholders in every neighborhood was set up. This network consisted of, amongst others, local primary healthcare providers (i.e., community nurses, physiotherapists, occupational therapists, GPs, and practice nurses), older adult unions, local initiatives for older adults, and volunteers. The network of stakeholders acted as an advisory body. Namely, during the study period, meetings were organized in order to discuss several topics related to the local implementation of the exercise program. This was particularly related to the recruitment of older adults. Also, the wishes, needs, and expectations of all stakeholders were discussed. In order to keep all stakeholders informed, a quarterly newsletter was sent to them and others interested.

Implementation

Implemented as planned

The twelve-week home-based fall prevention program was, except for two elements, implemented as planned. Two necessary adaptations were made during the program. Originally, adults were recruited in two Breda neighborhoods. As it became clear that relatively few older adults would enrol in the study, recruitment was extended to a total of eight neighborhoods. Furthermore, eight participants did not agree to a second home visit after twelve weeks. These participants received a follow-up questionnaire by regular mail instead.

Program satisfaction

A questionnaire on program satisfaction was conducted among the participants that completed the twelve-week program. Fifty-nine percent of the participants said that they moderately or strongly liked the program. The program was evaluated as at least moderately useful by 71% of the participants. Fifty-two percent of the participants agreed

or strongly agreed with noticing a change in the awareness of their fall risk during the study period (figure 2). Forty-three percent agreed or strongly agreed with noticing an increased confidence in their balance, and 37% agreed or strongly agreed with noticing a change in their level of physical activity during the study period.

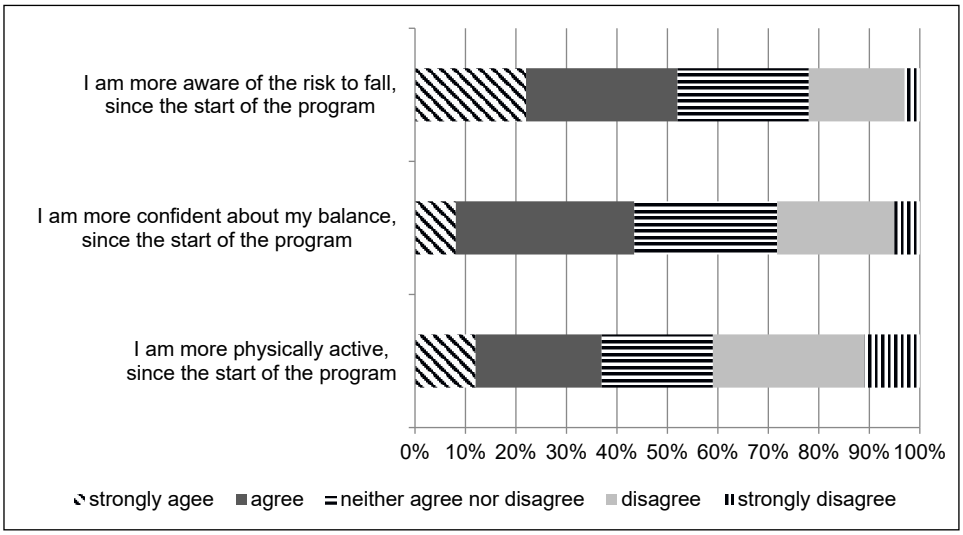

Figure 2. Program satisfaction of the participants after the twelve-week home-based exercise program.

Maintenance

In order to maintain the home-based exercise program locally, an invitational conference was organized after the study period. This conference included all relevant stakeholders, such as older adults living in Breda, the municipality, a health insurer, home care organizations, local initiatives, GP representatives, a hospital, and physical and occupational therapists. During the conference, a presentation was made by the research team on the process and results of implementing the exercise program in the community. A discussion followed, which led to three stakeholders with interest in taking over the responsibilities of structurally implementing and financing the fall prevention program locally.

Discussion

The current paper describes and evaluates the implementation of a home-based exercise program among older adults. The dialogues with healthcare professionals and older adults showed that, in order to stimulate participation rates among older adults, the negative consequences of a fall should be emphasized. The positive effects of preventing a fall, such as maintaining functional independence, should be emphasized, as well. According

to healthcare professionals and older adults, the informal caregiver is a key individual in stimulating participation among older adults. Using the framework model RE-AIM, the evaluation of implementing the home-based exercise program showed that many older adults were potentially reached, but relatively few enrolled in the study. Personal recruitment by their own community nurse was the most effective method of recruiting older adults. Furthermore, in the recruitment of older adults, a good collaboration between the research team and the local primary healthcare providers was important.

As reported previously, the current home-based exercise program was based on the intervention 'Senior Step'. In the evaluation study of this intervention, an information meeting was much more effective in reaching and recruiting participants than a personal approach [28]. This is in contrast to our study, as we did recruit some participants by providing information sessions, but the majority of participants were recruited face-to-face by a community nurse. An explanation for this difference could be that, in the 'Senior Step' study, older adults living in a residential care facility were recruited as well. A study on an integrated neighborhood approach to support community-dwelling older adults in the Netherlands showed that community engagement is very important in the adoption of a program [29]. Likewise, a study on the implementation of a fall prevention program in the United States reported that having solid community partnerships is essential for good program adoption by stakeholders [17]. These results correspond to our study, as creating broad support among local stakeholders proved to be important in successfully implementing the program. Keeping stakeholders informed during the study period has been found to be important in the implementation success of a previous fall prevention program, as well [13]. By sending newsletters and by organizing network meetings in our study, we tried to inform stakeholders, as well. The network meetings were important to take the wishes and needs of the local stakeholders of different neighborhoods into account, in order to properly adopt the program. This relates to a study by Peel et al. (2017), who reported that neighborhoods differ in many characteristics, so it is important to take into account the needs of the local area, in order to effectively adopt and implement a program [15].

The healthcare professionals of the Delphi survey considered the GP as a key individual in stimulating participation among older adults. However, involving GPs in the recruitment of participants proved to be difficult in our study. A study by Brach et al. (2013) on a home-based exercise program for older adults reported that they recruited GPs by contacting a research network [30]. The involvement of GPs in the recruitment of older adults proved to be beneficial in their study. Perhaps, if we had contacted GPs through a research network, a better collaboration could have been established. Apart from the recruitment of older adults, GPs could also have an important role in the adoption of an intervention. Previous research in the Netherlands has shown that the GP can have a central role in multidisciplinary teams, focused on the care for older adults [31]. The paper identifies several competences that

are key for a successful GP role, such as leadership and networking. A GP role with those competences could be of added value to the adoption of a fall prevention intervention.

After twelve weeks of follow-up, relatively low satisfaction of the program was reported by the participants, as 59% said that they liked the program. We have not asked why an individual did or did not like the program; however, a possible explanation for the relatively low satisfaction might be that older adults were missing support during the study period. Even though a member of the research team visited the participant twice at home (i.e., at baseline and after twelve weeks), no contact was made with the participant during the study period. Previous research has shown that support from others is considered important in the promotion and adherence of fall prevention interventions [12].

A strength of our study is that the comprehensive evaluation framework RE-AIM was used in order to evaluate the implementation. An evaluation such as this is valuable in translating research into practice. Also, using the different dimensions makes issues related to implementation more explicit, which is sometimes ignored in a more traditional presentation of results. A limitation of the current study is that processing qualitative data of the individual and group meetings with older adults could have been improved. Even though specific themes that emerged from the meetings were identified and clustered, no rigorous content analysis was performed, as it stretched beyond the scope of this study. This analysis could have yielded much richer insights of the important factors for fall prevention and should certainly be included in future research. Even though many older adults were potentially reached, relatively few enrolled in the study. This low willingness to participate could have resulted in selection bias. Nevertheless, despite not many older adults enrolling in the study, an increase in the awareness of fall prevention could still have been realized among this group. As Russell et al. (2017) have shown, the presence of risk awareness does not necessarily lead to older adults being willing to participate in fall prevention [32]. Another limitation of the study is that no information was available on what type or duration of exercises of the instruction book were performed by the participants. Thus, we were unable to determine what type or duration of exercises may have contributed to the effectiveness of the program. Participants of the current study might not be representative of a general population of community-dwelling older adults. Specifically, as the majority of older adults were recruited through healthcare professionals, the participants of the current study might be older and more frail than the general older adult population. Furthermore, relatively few participants with a migration background were included in the study. Only 6% of the older adult population of Breda has a migration background [33], but in other Dutch cities, this percentage is generally higher. The fact that individuals not understanding the Dutch language were excluded made it difficult for older adults with a migration background to enroll in our study. Even though ethnic minorities are often underrepresented in health research [34], some studies have shown effective methods to recruit immigrant participants.

Namely, by providing bilingual program information, and by facilitating partnerships with community organizations, recruitment of immigrant participants could be improved [35,36]. Future implementation studies should take into account these methods in the planning of their interventions.

Conclusions

This study shows that the negative consequences of a fall and the positive effects of preventing a fall should be emphasized to older adults, in order to get them engaged in fall prevention activities. Furthermore, the importance of a good collaboration between the research team and local primary healthcare providers has been identified. Also, particularly community nurses can successfully help in reaching and recruiting older adults for a fall prevention program. All lessons learned in the current study could help and guide future interventions of research projects to successfully translate into community-based programs. As the population ages and absolute numbers of fall-related injuries keep increasing, implementing successful prevention programs will become more and more important in reducing healthcare costs.

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Appendix

Table 1. Baseline characteristics of older adults that applied for the study, but that did not participate.

	Total (n=212)	**No informed consent (n=180)**	**Dropped out before start (n=32)**
	N (%)	N (%)	N (%)
Female	136 (65)[a]	116 (65)[e]	20 (65)[g]
Age - mean ± SD	82.3 ± 8.5[b]	82.2 ± 8.6[f]	82.7 ± 7.6[g]
Living alone	144 (69)[c]	123 (69)[e]	21 (66)
Elevated fall risk[1]	26 (81)	n.a.*	26 (81)

SD: Standard deviation; 1: The fall risk test (part of a fall analysis assessment) determined that an elevated fall risk was present when a participant had a fall in the past twelve months, or the participant had mobility problems and a fear of falling [37,38]; a: n=209; b: n=195; c: n=210; d: n=32; e: n=178; f: n=164; g: n=31.

7

Factors associated with participation of community-dwelling older adults in a home-based falls prevention program

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Abstract

This observational study was conducted to determine which factors are associated with frequent participation in a home-based exercise program. The effects of frequent participation on health-related outcomes over time are investigated, as well. Community-dwelling adults aged ≥65 years participated in a twelve-week home-based exercise program. The program consisted of an instruction book with exercises that were performed individually at home. Frequent participation was classified as performing exercises of the instruction book daily or a few days a week during the study period. A logistic regression analysis was performed to determine the association between factors (i.e., demographic and health-related characteristics) and frequent participation. Furthermore, to investigate the effects of frequent participation on health-related outcomes, generalized linear and logistic regression models were built. A total of 238 participants (mean age 81.1 years (SD ± 6.7), 71% female) were included in the study. Frequent participation during the study period was indicated by fifty-two percent of participants. Analyses showed that a higher degree of pain (OR: 1.02, 95% CI: 1.–1.04) was associated with frequent participation. In addition, the effect of frequent participation over time was a significant improvement in current health perceptions (B: 4.46, SE: 1.99).

Introduction

Falls among older adults are a global public health problem, with high levels of healthcare consumption and high costs [1,2]. In the Netherlands, from the years 2000 to 2017, the population aged ≥65 years increased by 47% to 3.2 million [3]. During that time, fall-related emergency department visits increased by 87% to 124,000 per year [4]. Due to an aging population, the number of falls is expected to further increase in the coming decades. Fortunately, previous studies have shown that prevention programs can reduce falls among community-dwelling older adults [5–8]. The majority of the proven-effective programs consist of an exercise component [5–8]. Even though many exercise programs are offered in a group on location, older adults appear to favor an individual, home-based exercise program [9]. Advantages of a home-based program are good accessibility and lower program costs, as no exercise room or physiotherapist needs to be arranged. The level of participation of older adults in home-based exercise programs is generally low [10]. However, high participation levels may lead to a reduced fall risk [11]. A systematic review and meta-analysis investigated the relationship between program features, level of participation, and the effectiveness of home-based exercise programs [10]. No association was found between level of participation and the effectiveness of a program; however, an association between program features and level of participation was found. Namely, including walking and balance exercise in the program and providing home visit support were associated with a higher level of participation in the program. To our knowledge, no study has investigated the association between participant characteristics, the level of participation, and the effectiveness of a home-based exercise program. This information could help in the planning of future falls prevention interventions. Therefore, the aims of this paper were to: (1) determine which participant characteristics are associated with frequent participation of community-dwelling older adults in a home-based exercise program; and (2) investigate the effects of frequent participation on health-related outcomes over time.

Materials and methods

Study design and population

In an observational study, community-dwelling adults aged ≥65 years, living in the city of Breda, in the Netherlands, were included in the study. Older adults living in a residential care facility, not understanding the Dutch language, or those with dementia were excluded from participation. All participants were offered a home-based exercise program for twelve weeks. At baseline and after twelve weeks of follow-up, a questionnaire was administered during home visits. Written informed consent was provided by all participants. The medical ethics committee of Erasmus MC, University Medical Center Rotterdam waived ethical approval of the study (number 2017-139).

Home-based exercise program

The home-based exercise program was based on the Senior Step intervention [12]. In the Senior Step intervention, participants performed self-tests for assessing mobility and fall risk. The safety and feasibility of these tests were evaluated in that study. Apart from the self-tests, participants were also offered an instruction book with exercises. The instruction book was developed by two physiotherapists and was based on the Otago program [13]. The book consists of exercises to: (1) promote safe use of walking aids, (2) improve mobility, (3) improve reaching (i.e., forwards, sideways, and backwards), (4) improve quality of walking and walking speed, and (5) improve overall fitness (i.e., agility, strength, balance, and conditioning). Amongst others, exercises consisted of walking up and down a slope with a walking aid, standing up from a chair, reaching for a kitchen cupboard, walking a figure eight, or walking up and down the stairs. The book is divided into four levels, ranging from simple, low-intensity to complex, intensive exercises. In the current study, the instruction book of the Senior Step intervention was offered to participants as a home-based exercise program, for twelve weeks. At baseline, a member of the research team visited the participant at home. During this home visit, the researcher gave the participant the instruction book, explained how to use it, and advised the participant about which exercise level would be appropriate for beginning the program. However, during the study period, participants could change which exercises they performed, and how often, without interference from the research team. After twelve weeks of follow-up, a member of the research team called the participant to schedule a second home visit. During this home visit, the instruction book was returned to the research team.

Recruitment

Between March 2017 and March 2018, participants were recruited through primary care health professionals, such as community nurses, physiotherapists, and general practitioners. Furthermore, information sessions and workshops were held in community centers, advertisements were published in local papers, and commercials were broadcasted on a local television and radio channel. Older adults could apply to participate in the study by telephone, regular mail, or email. When the research team received the application, participants were sent an informed consent form by regular mail. When the research team did not receive a signed informed consent form, the participant was reminded by telephone, regular mail, or email. Participants were called to schedule a first home visit when the research team received a signed informed consent form.

Outcome variables

Participant characteristics at baseline and follow-up

Data collection took place between July 2017 and June 2018, as baseline home visits were performed between July 2017 and March 2018, and follow-up home visits were performed between October 2017 and June 2018. The baseline and follow-up questionnaire on

participant characteristics included demographic characteristics, such as sex, age, living situation (i.e., alone or with someone else), and education. Education was classified as low (i.e., less than primary school, primary school, and little more than primary school), middle (i.e., technical school, vocational education, general secondary/pre-university education), and high (i.e., college/university). Several self-reported measurements were performed, as well. The five-dimensional EuroQol instrument (EQ-5D) and the domain cognition assessed the generic quality of life on the dimensions mobility, self-care, usual activities, pain and discomfort, anxiety and depression, and cognitive function [14]. Mean scores range from 0 (death) to 1 (full health). The fall risk test (part of a fall analysis assessment) determined that an elevated fall risk was present when a participant had a fall in the past twelve months, or the participant had mobility problems and a fear of falling [15,16]. The Timed "Up & Go" (TUG) measured the mobility, by measuring the time in seconds it took to stand up from a chair, walk three meters back and forth, and sit down again [17]. The Short Falls Efficacy Scale-International (Short FES-I) assessed the concern about falling [18]. The Self-Management Ability Scale Shorter (SMAS-S) determined self-management abilities, which was based on taking initiative, investment behavior, variety, multifunctionality, self-efficacy, and positive frame of mind [19]. Scores range from 0–100, a higher score means better self-management abilities. The Short-Form General Health Survey of the Medical Outcomes Study (SF-20) measured general health, which was based on physical functioning, role functioning, social functioning, mental health, current health perceptions, and pain [20]. Scores range from 0–100, a higher score means better functioning, and for pain, a higher score means a higher degree of pain.

Level of participation

After twelve weeks of follow-up, participants were asked how often they had performed the exercises outlined in the instruction book. Participants reported that the exercises were performed daily, a few days a week, one day a week, less than one day a week, or not at all. A review by Sherrington et al. (2016) has shown that participating in a falls prevention exercise program, for at least three hours a week, could reduce the fall rate among older adults [6]. We estimated that, in order to reach three hours of exercise, an individual should at least exercise a few days a week. Therefore, we decided to classify an individual who performed exercises daily or a few days a week as having 'frequent participation'. 'Infrequent or nonparticipation' was classified as performing exercises one day a week, less than one day a week, or not at all. The reasons study participants gave for not frequently participating were recorded after twelve weeks as well. As the level of participation is based on self-report, it could have been influenced by social desirability bias. By consistently collecting data in the same way during home visits, an attempt was made to minimize potential bias.

Statistical analyses

Baseline characteristics

The frequencies of baseline characteristics of all participants were determined. Continuous variables are expressed as mean and standard deviation (SD), and dichotomous variables are expressed as number (n) and percentage (%).

Association between factors and frequent participation

In order to determine the baseline differences between frequent and infrequent or nonparticipating individuals, an independent samples t-test was performed on continuous variables, whereas a Chi-squared test was performed on dichotomous variables. These analyses were performed to determine the baseline differences between completers and dropouts, as well. The association between factors and frequent participation was determined by performing a logistic regression analysis, in which frequent participation was used as a dependent variable. Factors included the baseline demographic characteristics sex, age, living situation, and education. Furthermore, the follow-up health-related outcomes quality of life, fall risk, mobility, fear of falling, self-management, and general health were included. In the univariate logistic regression analysis, the crude association between the factors and frequent participation was calculated. The variables that had a crude association with frequent participation, with a p-value < 0.20, were selected for multivariable model 1. An adjustment for other baseline confounders was performed in multivariable model 2. The confounders of model 2 were selected by investigating the baseline differences between the frequent and infrequent or nonparticipation groups. If a variable differed between the groups with a p-value < 0.20, this variable was selected. Results of the univariate and multivariable analysis are expressed as odds ratio (OR) and 95% confidence interval (CI).

Effects of frequent participation on health-related outcomes

To investigate the effects of frequent participation on health-related outcomes, generalized linear and logistic regression models were built, in which follow-up health-related outcomes were used as a dependent variable. A generalized linear regression analysis was performed on continuous health-related outcomes and a generalized logistic regression analysis was performed on dichotomous health-related outcomes. Health-related outcomes included follow-up quality of life, fall risk, mobility, concern about falling, self-management, and general health. In multivariable model 1, the crude effect of frequent participation on health-related outcomes was adjusted for the baseline variable. An adjustment for the baseline variable and other baseline confounders was performed in multivariable model 2. The confounders of model 2 were selected by investigating the baseline differences between the frequent and infrequent or nonparticipation groups. If a variable differed between the groups with a p-value < 0.20, this variable was selected for multivariable model 2. Results of the logistic regression analysis are expressed as OR and 95% CI, whereas results of the linear regression analyses are expressed as Beta (B) and standard error (SE).

Multicollinearity

To take into account the presence of multicollinearity [21], multiple analyses were performed. The correlations between all independent variables were calculated, and expressed as Pearson correlation coefficients (r). The correlation between two variables is assumed to be low (r = 0.30–0.50), moderate (r = 0.50–0.70), or high (r = 0.70–0.90) [22]. Another way to detect multicollinearity is by calculating a variance inflation factor (VIF). A VIF has been calculated for all independent variables, of which a VIF larger than five or ten is suggested to detect multicollinearity [23]. As baseline and follow-up questionnaires were filled in properly (less than 9% missing data), no imputation measures were considered. A p-value < 0.05 was considered statistically significant. All analyses were performed using SPSS Statistical Data software (IBM), version 24.

Results

Baseline characteristics

A total of 238 adults aged ≥65 years participated in the study, of which 195 participants (82%) completed the twelve-week program (figure 1). The mean age of all participants was 81.1 years (SD ± 6.7) (table 1). The majority of participants were women (71%), living alone (63%), with a middle level education (55%), and with an elevated fall risk (69%). No statistically significant baseline differences between completers and dropouts were observed (appendix table 1).

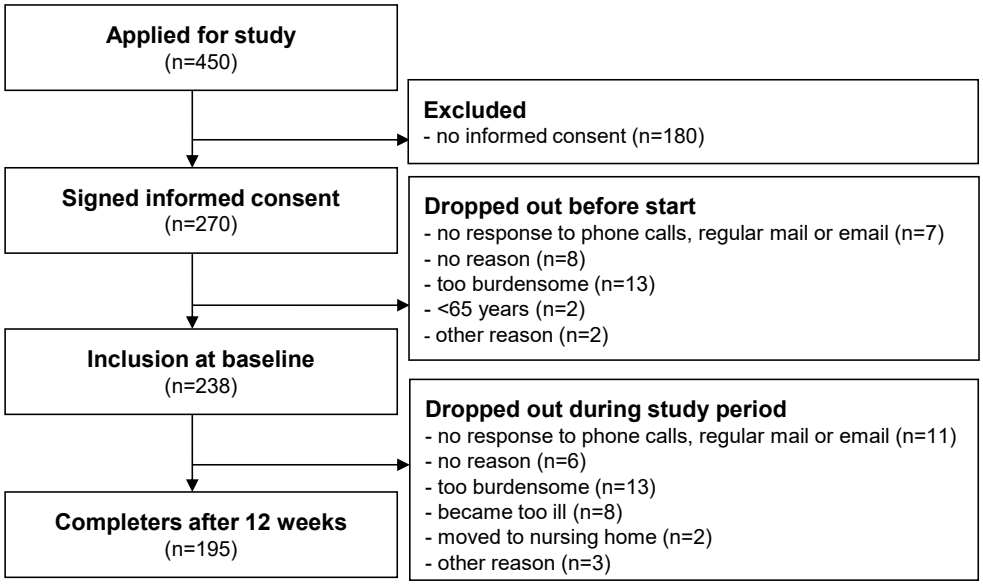

Figure 1. Flowchart of participants in the home-based exercise program.

Table 1. Baseline characteristics, and differences between individuals frequently and infrequently or not participating in the home-based exercise program.

	All Participants (*n* = 238)	**Total Frequent and Infrequent or Nonparticipation (*n* = 195)**	**Frequent Participation (*n* = 102)**	**Infrequent or Nonparticipation (*n* = 93)**	**Difference between Frequent and Infrequent or Nonparticipation ***
	n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Demographic characteristics					
Female	169 (71)	140 (72)	76 (75)	64 (69)	0.38
Age—mean ± SD	81.1 ± 6.7	80.9 ± 6.6	80.6 ± 6.4	81.3 ± 6.8	0.46
Living alone	151 (63)	124 (64)	66 (65)	58 (62)	0.73
Education					
low	70 (29)	53 (27)	24 (24)	29 (31)	0.23
middle	130 (55)	108 (55)	56 (55)	52 (56)	0.89
high	38 (16)	34 (17)	22 (22)	12 (13)	0.11
Health-related outcomes	mean ± SD	mean ± SD	mean ± SD	mean ± SD	*p*-value
Quality of life (EQ-5D + cognition) [1]	0.64 ± 0.24	0.65 ± 0.24	0.70 ± 0.23	0.60 ± 0.24	0.00
Elevated fall risk—n (%)	161 (69) [a]	133 (69) [d]	65 (64) [g]	68 (75) [i]	0.12
Mobility (TUG) in seconds	17.0 ± 9.1 [b]	16.9 ± 8.9 [e]	16.2 ± 7.9 [h]	17.6 ± 10.0 [j]	0.29
Concern about falling (Short FES-I)	9.8 ± 4.0	9.8 ± 3.9	9.9 ± 3.6	9.7 ± 4.1	0.77
Self-management (SMAS-S) [2]	59.3 ± 16.2 [c]	60.1 ± 16.0 [f]	63.8 ± 14.9	56.1 ± 16.3 [k]	0.00
General health (SF-20) [3]					
physical functioning	45.1 ± 31.7 [c]	45.1 ± 31.6 [f]	50.2 ± 32.0	39.5 ± 30.2 [k]	0.02
role functioning	28.8 ± 41.4	29.2 ± 41.1	34.3 ± 43.9	23.7 ± 37.3	0.07
social functioning	72.5 ± 34.0	74.5 ± 32.7	76.3 ± 32.5	72.5 ± 33.0	0.42
mental health	73.0 ± 20.7 [c]	73.2 ± 20.8 [f]	74.1 ± 20.8 [g]	72.3 ± 20.7	0.55
current health perceptions	46.4 ± 21.1 [c]	46.9 ± 21.1 [f]	47.1 ± 20.5	46.7 ± 21.9 [k]	0.89
pain	33.0 ± 27.6	31.9 ± 27.8	35.8 ± 27.1	27.7 ± 27.9	0.04

SD: Standard deviation; [1]: Mean scores range from 0 (death) to 1 (full health); [2]: Scores range from 0–100, a higher score means better self-management abilities; [3]: Scores range from 0–100, a higher score means better functioning, and for pain, a higher score means a higher degree of pain; [a]: *n* = 235; [b]: *n* = 217, as twenty-one participants were not able to do the test; [c]: *n* = 237; [d] *n* = 192; [e] *n* = 178, as seventeen participants were not able to do the test; [f] *n* = 194; [g] *n* = 101; [h] *n* = 96, as six participants were not able to do the test; [i] *n* = 91; [j] *n* = 82, as eleven participants were not able to do the test; [k] *n* = 92; *: Independent samples *t*-test for continuous variables, Chi-squared test for dichotomous variables. A *p*-value < 0.05 is considered a statistically significant difference.

Association between factors and frequent participation

Fifty-two percent (*n* = 102/195) of the participants performed exercises of the home-based exercise program daily (*n* = 57) or a few days a week (*n* = 45), and so were classified as the frequent participation group. The infrequent or nonparticipation group consisted of participants performing exercises one day a week (*n* = 18), less than one day a week (*n* = 22), or not at all (*n* = 53). The most important reasons for not frequently participating, mentioned by the participants, were 'exercises are too easy' (29%), and 'poor health' (21%). At baseline, the demographic characteristics did not significantly differ between the frequent and infrequent or nonparticipation groups (table 1). Health-related outcomes did differ significantly between the two groups, as the frequent participation group had a significantly higher quality of life, better self-management abilities, and better physical functioning (SF-20), than the infrequent or nonparticipation group. A significantly higher degree of pain (SF-20) was indicated by the frequent participation group, as well. In the univariate logistic regression analysis, a higher quality of life and better self-management abilities were significantly associated with frequent participation (table 2). One factor that was not significantly associated in the univariate analysis, was significantly associated in multivariable models 1 and 2. Namely, a higher degree of pain (SF-20) was associated with frequent participation in multivariable model 1 (OR: 1.02, 95% CI: 1.01–1.04) and model 2 (OR: 1.02, 95% CI: 1.00–1.04).

Table 2. Factors associated with frequent participation in the home-based exercise program.

	Univariate		Multivariable Model 1 †		Multivariable Model 2 ‡	
	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Female	1.33 (0.71–2.48)	0.38	1.40 (0.66–2.98)	0.38	1.12 (0.50–2.47)	0.79
Age	0.98 (0.94–1.03)	0.46	1.01 (0.96–1.06)	0.78	1.01 (0.95–1.06)	0.82
Living alone	1.11 (0.62–1.98)	0.73	0.88 (0.45–1.74)	0.72	0.82 (0.40–1.68)	0.59
Education						
low	0.68 (0.36–1.28)	0.23	1.14 (0.55–2.37)	0.72	1.51 (0.68–3.36)	0.32
middle	0.96 (0.55–1.69)	0.89	0.88 (0.42–1.82)	0.72	0.66 (0.30–1.48)	0.32
high	1.86 (0.86–4.00)	0.12	1.93 (0.83–4.46)	0.13	1.47 (0.60–3.62)	0.40
Quality of life (EQ-5D + cognition)	3.52 (1.16–10.71)	0.03	1.39 (0.21–9.31)	0.73	0.63 (0.07–6.12)	0.63
Elevated fall risk	0.72 (0.41–1.27)	0.25	1.00 (0.49–2.03)	1.00	0.96 (0.43–2.18)	0.93
Mobility (TUG) in seconds	0.99 (0.96–1.03)	0.72	1.02 (0.97–1.07)	0.47	1.01 (0.95–1.06)	0.84
Concern about falling (Short FES-I)	1.02 (0.96–1.09)	0.50	1.07 (0.98–1.17)	0.12	1.08 (0.98–1.18)	0.14
Self-management (SMAS-S)	1.03 (1.01–1.05)	0.00	1.02 (1.00–1.05)	0.09	1.01 (0.98–1.04)	0.64
General health (SF-20)						
physical functioning	1.01 (1.00–1.02)	0.07	1.00 (0.99–1.02)	0.67	1.00 (0.99–1.02)	0.69
role functioning	1.01 (1.00–1.01)	0.09	1.00 (0.99–1.01)	0.50	1.01 (0.99–1.02)	0.41
social functioning	1.01 (1.00–1.01)	0.27	1.00 (0.99–1.01)	0.89	1.00 (0.99–1.01)	0.91
mental health	1.00 (0.99–1.02)	0.70	0.99 (0.97–1.01)	0.20	0.98 (0.96–1.00)	0.98
current health perceptions	1.01 (1.00–1.02)	0.14	1.01 (0.99–1.03)	0.27	1.01 (0.99–1.04)	0.19
pain	1.01 (1.00–1.02)	0.10	1.02 (1.01–1.04)	0.00	1.02 (1.00–1.04)	0.02

†: Adjusted for baseline high education, and follow-up quality of life, self-management, physical functioning, role functioning, current health perceptions, and pain; ‡: Adjusted for baseline high education, quality of life, elevated fall risk, self-management, physical functioning, role functioning and pain, and follow-up quality of life, self-management, physical functioning, role functioning, current health perceptions, and pain; A *p*-value <0.05 is considered a statistically significant difference.

Effects of frequent participation on health-related outcomes

In multivariable model 1, the effect of frequent participation over time was a significant improvement in current health perceptions (SF-20) (B: 4.49, SE: 2.01) (table 3). This effect was observed in multivariable model 2, as well (B: 4.46, SE: 1.99). The direction of this change can be derived from appendix table 2, which shows the baseline and follow-up health-related outcomes of individuals frequently participating in the program.

Table 3. Effects of frequent participation in the home-based exercise program on health-related outcomes.

	Multivariable Model 1 †		**Multivariable Model 2** ‡	
Logistic Regression	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Elevated fall risk	0.85 (0.43–1.71)	0.65	0.90 (0.42–1.94)	0.79
Linear regression	B (SE)	*p*-value	B (SE)	*p*-value
Quality of life (EQ-6D)	0.01 (0.03)	0.78	0.01 (0.03)	0.82
Mobility (TUG) in seconds	−0.10 (0.94)	0.92	−0.57 (0.91)	0.53
Concern about falling (Short FES-I)	0.30 (0.50)	0.55	0.56 (0.51)	0.27
Self-management (SMAS-S)	1.79 (1.55)	0.25	1.20 (1.58)	0.45
General health (SF-20)				
physical functioning	0.59 (3.49)	0.87	1.38 (3.53)	0.70
role functioning	2.91 (4.23)	0.49	2.43 (4.08)	0.55
social functioning	3.51 (4.32)	0.42	1.97 (4.37)	0.65
mental health	−0.29 (2.01)	0.89	−0.49 (2.06)	0.81
current health perceptions	4.49 (2.01)	0.03	4.46 (1.99)	0.03
pain	3.04 (3.59)	0.40	6.62 (3.60)	0.07

†: Adjusted for the baseline variable; ‡: Adjusted for the baseline variable, and baseline high education, quality of life, elevated fall risk, self-management, physical functioning, role functioning, and pain; A p-value < 0.05 is considered a statistically significant difference.

Multicollinearity

As shown in table 2, the variable pain was not significantly associated in the univariate analyses but was significantly associated in multivariable model 1 and 2. Therefore, multicollinearity could have influenced the results. The variable pain has a low correlation (0.30–0.50) with six independent variables. Furthermore, this variable does not have a VIF larger than three.

Discussion

The current study showed that 52% of the participants performed the exercises of the home-based exercise program frequently during the entire study period. At baseline, the frequent participation group had a significantly higher quality of life, better self-management abilities, better physical functioning, and a higher degree of pain than the infrequent or

nonparticipation group. A higher degree of pain was associated with frequent participation. Also, our study observed that the effect of frequent participation over time was a significant improvement in current health perceptions. Several other studies have found that participation in an exercise program resulted in better health perceptions. Namely, three studies have shown that, among older adults, participation in a community exercise group, in a Pilates exercise group, or in Tai Chi has resulted in better health perceptions [24–26].

Frequent participation in the program was not associated with a lower fall risk or better mobility. An explanation could be that the study period was not long enough to detect clear associations or effects. For example, a meta-analysis of four Otago studies showed a reduction in falls and improvement in balance; however, fall events and balance were monitored for at least 44 weeks, whereas our study had only twelve weeks of follow-up [27]. A positive association between good self-rated health and participation has been observed in previous studies. Namely, among Mexican older adults, good self-rated health was associated with practicing regular physical activity [28]; among community-dwelling Japanese older adults, it was associated with high participation in sports groups [29]; and among community-dwelling white American older adults, it was associated with engaging in medium- or high-intensity activity [30]. In our study, we did not observe an association between good self-rated general health (SF-20) and frequent participation. An explanation for these differences in study results could be that 'exercise participation' was defined differently. Specifically, the cohort studies performed in Mexico, Japan, and in the United States classified participation as all physical activity that was performed in the past twelve months, whereas we classified participation as physical activity that was performed only in the exercise program. Furthermore, Hawley-Hague et al. (2016) published a review on studies reporting the level of participation of older adults in exercise programs [31]. They showed that there was hardly any consensus between studies on how to define the level of participation. Instead of an association between good self-rated health and participation, we observed that a higher degree of pain (SF-20) was associated with frequent participation. This could partly be explained by differences between participation groups at baseline. Specifically, at baseline, the frequent participation group had a higher degree of pain than the infrequent or nonparticipation group. However, the question remains why individuals with a higher degree of pain were more likely to participate frequently in the exercise program. A systematic review on older adults' perspectives reported that pain can be a barrier or facilitator for participation [32]. Even though exercise can be perceived as physically demanding, some older adults exercise in order to deal with or relieve pain. The percentage of individuals with frequent participation was relatively high in our study (52%), as a systematic review and meta-analysis showed that, on average, 21% of older adults are adherent in exercise interventions [10]. This can be explained by the fact that the program of the current study included balance and walking exercise, which have shown to increase participant adherence [10]. The participation level of the individuals who participated

infrequently or not at all might have been higher if the exercises had been more challenging, as 29% of the participants mentioned that the exercises were too easy. A study by Elskamp et al. (2012) reported a similar result, as the older adults that refused to participate in their falls prevention interventions considered themselves to be too healthy [33].

Interestingly, a relatively old population (mean age 81.1 years) participated in the current study. The fact that the majority of participants were recruited through primary care health professionals, such as community nurses, could be an explanation. As in general, the oldest old receive homecare, this could have resulted in a relatively old population in the study. Another explanation could be that 'younger' older adults (i.e., those aged 64–75 years) prefer a group-based falls prevention program, whereas the oldest old prefer a home-based program [9]. As reported earlier in the results, the presence of multicollinearity could be an explanation for the variable pain to become statistically significant in the multivariable model 1 and 2. However, as the correlation with other independent variables is low, and it did not have a VIF larger than three, it is unlikely that multicollinearity has influenced the results. A strength of our study is that it resembles a real-life situation. Namely, in comparison to a program offered in a group on location, the participants of the current study could choose which home-based exercises they performed, and how often, without interference from the research team or a physiotherapist. Another strength of the study was that adherence was good, as 82% of the participants completed the program, with few avoidable dropouts. Furthermore, no statistically significant baseline differences between completers and dropouts were observed. A limitation of our study is that the level of participation was based on self-report and so is subject to social desirability bias. If participation had been monitored by the research team during the study period, participation levels might have been different. For example, if participation levels had been measured again after six weeks, the research team could have guided participants to exercise more often, which could have changed participation levels. However, this would have detracted from the real-life nature of this falls prevention program. In addition, the level of participation was administered with an ordinal scale. This has reduced the precision of the measurement. Another limitation was that no information was available on what type or duration of exercises of the instruction book were performed by the participants. Therefore, we were unable to determine what type or duration may have contributed to the changes in the outcomes. Furthermore, other physical activity, performed outside of the study, was not assessed and thus could not be adjusted for in the analyses. The studied population might not be representative of general community-dwelling older adults. Specifically, as the majority of older adults were recruited through primary care health professionals, the participants of the current study might have been older and more frail than the general older adult population. Therefore, selection bias might have been present.

Conclusions

This study shows that the participant characteristic pain was associated with frequent participation in a home-based exercise program. Furthermore, the effect of frequent participation over time was a significant improvement in current health perceptions (SF-20). These characteristics should be taken into account in the planning of future falls prevention interventions. By monitoring these characteristics during an intervention, it is possible to guide and motivate specific participants, so that frequent participation rates will increase.

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Appendix

Table 1. Baseline characteristics of completers and drop-outs of the home-based exercise program, and differences between both groups.

	Completers (n=195)	**Drop-outs (n=43)**	**Difference between completers and drop-outs***
Demographic characteristics	*n (%)*	*n (%)*	*p-value*
Female	140 (72)	29 (67)	0.57
Age - mean ± SD	80.9 ± 6.6	82.2 ± 6.9	0.24
Living alone	124 (64)	27 (63)	0.92
Education			
low	53 (27)	17 (40)	0.11
middle	108 (55)	22 (51)	0.62
high	34 (17)	4 (9)	0.19
Health-related outcomes	*mean ± SD*	*mean ± SD*	*p-value*
Quality of life (EQ-5D + cognition)[1]	0.65 ± 0.24	0.61 ± 0.23	0.35
Elevated fall risk - n (%)	133 (69)[a]	28 (65)	0.60
Mobility (TUG) in seconds	16.9 ± 8.9[b]	17.8 ± 9.8[d]	0.58
Concern about falling (Short FES-I)	9.8 ± 3.9	9.7 ± 4.7	0.84
Self-management (SMAS-S)[2]	60.1 ± 16.0[c]	55.4 ± 16.5	0.08
General health (SF-20)[3]			
physical functioning	45.1 ± 31.6[c]	45.0 ± 32.4	0.98
role functioning	29.2 ± 41.1	26.7 ± 42.7	0.72
social functioning	74.5 ± 32.7	63.7 ± 38.6	0.10
mental health	73.2 ± 20.8[c]	72.3 ± 20.5	0.79
current health perceptions	46.9 ± 21.1[c]	44.1 ± 21.4	0.43
pain	31.9 ± 27.8	37.8 ± 26.9	0.21

SD: Standard deviation; [1]: Mean scores range from 0 (death) to 1 (full health); [2]: Scores range from 0-100, a higher score means better self-management abilities; [3]: Scores range from 0-100, a higher score means better functioning, and for pain, a higher score means a higher degree of pain; [a]: n=192; [b]: n=178, as seventeen participants were not able to do the test; [c]: n=194; [d]: n=39, as four participants were not able to do the test; *: Independent samples t-test for continuous variables, Chi-squared test for dichotomous variables. A p-value <0.05 is considered a statistically significant difference.

Table 2. Baseline and follow-up health-related outcomes of individuals frequently participating in the home-based exercise program.

	Baseline frequent participation (n=102)	**Follow-up frequent participation (n=102)**
Health-related outcomes	*mean ± SD*	*mean ± SD*
Quality of life (EQ-5D + cognition)[1]	0.70 ± 0.23	0.70 ± 0.26[c]
Elevated fall risk - n (%)	65 (64)[a]	
Mobility (TUG) in seconds	16.2 ± 7.9[b]	16.9 ± 9.1[d]
Concern about falling (Short FES-I)	9.9 ± 3.6	9.9 ± 4.3[c]
Self-management (SMAS-S)[2]	63.8 ± 14.9	61.6 ± 14.5
General health (SF-20)[3]		
physical functioning	50.2 ± 32.0	51.7 ± 31.1[e]
role functioning	34.3 ± 43.9	36.3 ± 42.3
social functioning	76.3 ± 32.5	73.9 ± 33.4
mental health	74.1 ± 20.8[a]	75.1 ± 20.8
current health perceptions	47.1 ± 20.5	49.0 ± 19.4[c]
pain	35.8 ± 27.1	36.0 ± 26.7

SD: Standard deviation; [1]: Mean scores range from 0 (death) to 1 (full health); [2]: Scores range from 0-100, a higher score means better self-management abilities; [3]: Scores range from 0-100, a higher score means better functioning, and for pain, a higher score means a higher degree of pain; [a]: n=101; [b]: n=96, as six participants were not able to do the test; [c]: n=101; [d]: n=82, as twenty participants were not able to do the test; [e]: n=100.

8

Personal preferences of participation in fall prevention programmes: a descriptive study

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Abstract

Background: Participation in fall prevention programmes is associated with lower risk of injurious falls among older adults. However, participation rates in fall prevention interventions are low. The limited participation in fall prevention might increase with a preference based approach. Therefore, the aims of this study are to a) determine the personal preferences of older adults regarding fall prevention and b) explore the association between personal preferences and participation.

Methods: We assessed the personal preferences of older adults and the association between their preferences, chosen programme and participation level. Nine different programmes, with a focus on those best matching their personal preferences, were offered to participants. Twelve weeks after the start of the programme, participation was assessed by questionnaire. Logistic regression was performed to test the association between preferences and participation and an ANOVA was performed to assess differences between the number of preferences included in the chosen programme and participation level.

Results: Of the 134 participants, 49% preferred to exercise at home versus 43% elsewhere, 46% preferred to exercise alone versus 44% in a group and 41% indicated a programme must be free of charge while 51% were willing to pay. The combination of an external location, in a group and for a fee was preferred by 27%, whereas 26% preferred at home, alone and only for free. The presence of preferences or the extent to which the programme matched earlier preferences was not associated with participation.

Conclusion: Despite the fact that preferences can vary greatly among older adults, local programmes should be available for at least the two largest subgroups. This includes a programme at home, offered individually and for free. In addition, local healthcare providers should cooperate to increase the accessibility of currently available group programmes.

Background

Fall-related injuries have a substantial impact on the quality of life of individuals and on health care costs, making them a major public health problem [1,2]. More than one-third of community-dwelling older adults, aged ≥65 years fall each year [3,4]. In 70% of the falls, medical treatment is required. In the year 2018, within the Netherlands, falls among older adults resulted in 108.000 emergency department visits. In 70% of these visits older adults suffered from a severe injury and 33% required hospital admission. Eventually falls among older adults led to 4.396 deaths [3]. The number of fall accidents is rising, partly due to the aging population and it is expected that this rise will continue [3,5,6].

Many fall prevention interventions have been developed, with attention to different risk areas. Movement only interventions, generally consisting of movement or balance training, have shown to be associated with lower risk of injurious falls [7]. Multifactorial fall prevention interventions focus on more than one of the following risk areas: mobility and balance, safety in and around the house, medication use, vitamin D and vision impairment [7,8]. Within fall accidents multiple of these areas are important, which is why multifactorial interventions are more effective in reducing falls and fall risk [7–10].

However, participation rates in fall prevention interventions, single or multifactorial, are low [11]. It is estimated by health- care professionals that only 0–40% of older adults are reached for fall risk detection [12] and older adults that are reached are mainly those that indicate concerns themselves [13]. However, most older adults are either not aware of their fall risk [14], or they are not inclined to participate in fall prevention [15]. Personal factors, such as a low perception of the personal relevance of fall prevention programmes, and transportation problems are among the reasons to reject fall prevention interventions, even when they are offered [16–18]. Individually tailored fall prevention programmes might increase the chance that older adults will like and enjoy the programme, which has a positive influence on participation rates and active participation [18–21].

Existing studies mostly focus on barriers and motivators or the attitudes older adults have towards fall prevention. A few studies have reported programme preferences, showing that older adults seem to favour programmes with social contacts, of low intensity, free of charge and that are home based [20,22–24]. When asked what kind of fall risk reducing programme they would be willing to participate in, Dutch older adults seem to prefer a programme consisting of exclusively home visits above programmes in their neighbourhood, by television, internet or telephone [25]. Nevertheless, these preferences or the willingness to participate do not guarantee actual participation. Besides, having a choice of interventions and programmes tailored to persons' needs are mentioned as facilitators by older adults to participate in fall prevention programmes [22]. However, these studies did not investigate

whether participation rates actually increase as a result. Therefore, in our study, we offered a wide variety of preference-based fall prevention programmes in order to investigate whether such an approach could stimulate participation. Therefore, the aims of this study are to determine; a) what the personal preferences of older adults are in participating in a fall prevention programme, and b) if there is an association between personal preferences and participation.

Methods

This study was conducted from June 2017–December 2018 among community-dwelling adults aged ≥65 years, living in the city of Breda, in the Netherlands. Within this study, older adults received an overview of the fall prevention programmes available in their neighbourhood, highlighting those best matching their own preferences. Older adults were free to choose any programme they preferred, even if it was a poorer match to their previously indicated preferences. A questionnaire was administered at baseline and 12 weeks after commencement of the chosen programme. Not understanding the Dutch language, having dementia and living in a residential care facility were exclusion criteria. All participants provided informed consent. The medical ethics committee of Erasmus MC, University Medical Center Rotterdam reviewed the study and cleared ethical approval (number 2017–139).

Fall prevention programmes

Fall prevention programmes were offered with an integrated neighbourhood approach to achieve a better balance between community-dwelling older adults in need for care and local healthcare givers [26,27]. To achieve this balance, for every neighbourhood a profile was developed, relevant stakeholders were approached, and different meetings were organized with these stakeholders to discuss the implementation of the programmes. Among the stakeholders were local healthcare providers, organizations representing older adults, volunteers, and representatives of local initiatives for older adults [28]. They partly facilitated the recruitment, in addition to the recruitment of the research team, and offered the fall prevention programmes. With this collaboration, older adults could participate in a programme of their own choice promoted and provided by a local healthcare provider (e.g. physiotherapist). Besides, due to this neighbourhood approach, participants could choose a programme in a close proximity of their home. This reduced travel distance, an important barrier. A total of nine exercise-based fall prevention programmes were offered in the city of Breda. The number of programmes available within each neighbourhood differed, but there was a minimum of four programmes per neighbourhood. The programmes available on offer were ‘In balans’, ‘Vallen verleden tijd’, ‘Otago’, ‘Zicht op evenwicht’, ‘Samen door’, ‘Senior Stap’, ‘Valanalyse’, senior fitness, and individual physiotherapy [9,10,29–33]. More

information about the programmes can be found in table 1. The programmes are a mix of evidenced based and non-evidenced based programmes in order to provide a varied offer of fall prevention programmes within each neighbourhood. The options 'Otago' and 'Zicht op evenwicht' were both offered individually and based on the evidence-based options. Therefore, within our analyses these programmes are grouped together. The focus of this study is not the effect of the programmes on falls or fall risk but exploring the preferences older adults had and how this was associated with participation.

Preferences and baseline characteristics

Participants were recruited through various methods. Among them were press releases, commercials and personal contact through local healthcare professionals such as community nurses and physiotherapists. In this way, we aimed to reach as many older adults in the city of Breda as possible. Older adults that met the inclusion criteria but were not living alone or were not vulnerable participated in a separate part of the study, described in a previous publication [34]. A more detailed description of the recruitment of participants is described in earlier publications detailing the senior step programme and investigating the implementation of the senior step programme [28,34]. Once participants applied for the study, an informed consent form was sent by mail, accompanied by questions to assess fall risk. After written informed consent was provided, participants were telephoned by a member of the research team to assess their personal preferences and an appointment was scheduled to administer a baseline questionnaire. It was intended to administer this questionnaire during a home visit. However, due to the time investment of visiting participants at home, we could not offer all participants this home visit, and the questionnaire was administered by telephone in some instances.

Fall risk

A history of falls and problems with movement and balance are associated with a higher chance of recurrent falls [35]. The instrument used to assess fall risk in this study is based on these two factors and was assessed by three questions; 1) Did you fall in the past 12 months?; 2) Do you experience problems with movement and balance?; and 3) Are you afraid of falling? Older adults that answered yes on question one, or on two out of the three questions, were considered as having a high fall risk. Although this test is not yet validated, it is part of the Dutch national guidelines for assessing fall risk among community-dwelling older adults [33].

Table 1. Available programmes

Programme	EB	HCW involved	Preferences	Content	Main focus
In Balans (in balance)	Yes	Physiotherapist	1 = Location, 2 = Group, 3 = Pay, 4 = Fixed, 5 = Low, 6 = Social, 7 = Together	Exercise training and information sessions	Increase risk awareness and improve balance, mobility, physical fitness and selfconfidence
Vallen verleden tijd (falls in the past)	Yes	Physiotherapist	1 = Location, 2 = Group, 3 = Pay, 4 = Fixed, 5 = High, 6 = Social, 7 = Together	Obstacle course, sports and games and fall techniques	Improve mobility and reduce fear of falling
Otago	Yes	Physiotherapist	1 = Home & Location, 2 = Individually, 3 = Free, 4 = Own, 5 = Low, 6 = Sportive, 7 = Together	Leg and balance exercises and a walking program	Improve muscle strength and balance
Zicht op evenwicht (a matter of balance)	Yes	Physiotherapist	1 = Home & Location, 2 = Individually, 3 = Free, 4 = Own, 5 = Low, 6 = Sportive, 7 = Together	Information and behavior change by cognitive behavioral principles together with exercises	Reduce fear of falling
Senior step	No	Alone	1 = Home, 2 = Individually, 3 = Free, 4 = Own, 5 = Low, 6 = Sportive, 7 = Separate	Instruction book with exercises	Improve balance, mobility and strength
Samen door (go together)	No	Volunteer	1 = Home, 2 = Individually, 3 = Free, 4 = Own, 5 = Low, 6 = Sportive, 7 = Together	Easy to perform exercises addressed to the needs of the participant	To be more independent
Valanalyse (fall analyses)	No	Occupational therapist	1 = Home, 2 = Individually, 3 = Free, 4 = Own, 5 = Low, 6 = Sportive, 7 = Together	Risk assessment and a tailored advice. Besides exercise training, risk factors like medication are taken into account.	Reduce the risk of falling
Senior fitness	No	Physiotherapist	1 = Location, 2 = Group, 3 = Pay, 4 = Fixed, 5 = Low, 6 = Social, 7 = Together	Exercise training	Improve balance and mobility
Individual physiotherapy	No	Physiotherapist	1 = Home & Location, 2 = Individually, 3 = Free, 4 = Own, 5 = Low, 6 = Sportive, 7 = Together	Exercise training	Improve balance and mobility

Note: EB Evidenced based, HCW Healthcare worker. Preferences presented are 1) At home or at location, 2) In a group or individually, 3) Payment necessary or for free, 4) Fixed times or own time, 5) Low or high intensity (as indicated by the healthcare provider that offers the programme), 6) Sportive or social factors, 7) Genders separated or together

Preferences

Preferences of participating in a fall prevention programme were collected by telephone, using seven questions with two answer options. The questions posed were drafted during a focus group together with a panel of older adults, in a participatory design approach. These older adults were part of a forum, which aims to improve the quality of life and care of older adults [36]. The group consisted of older adults, mean age 73 years, with equal proportions of men and women. Some of the panel members had a background in healthcare or experiences as a patient or caregiver and others had no specific background with healthcare. The following questions to assess older adults' preferences were formulated: Do you prefer a programme; 1) at home or at an external location? 2) individually or in a group? 3) requiring payment or do you only want to participate if it is for free? 4) at fixed times or whenever it is convenient for you? 5) at a high or low intensity? 6) with more focus on sport or more on social factors? 7) with men or women separately, or together?

Baseline characteristics

A baseline questionnaire was assessed by a member of the research team during a home visit or by telephone. This questionnaire was a combination of the TOPICS-MDS and the EQ-5D + cognition questionnaire [37,38]. The TOPICS-MDS is a validated questionnaire and advised for use in a geriatric population [38]. It includes items on sociodemographic characteristics, such as age, gender, living situation, marital status, country of birth, education level and diseases experienced during the last 12 months. Education was arranged in low (less than primary school, primary school, and a little more than primary school), middle (i.e. technical school, vocational education, general secondary/pre-university education), and high (i.e. college/university). For diseases a list of seventeen diseases was listed as used in the TOPIC-MDS. In addition, an option 'other disease' was added. Participants could indicate whether they had experienced the disease in the last 12 months. Health-related quality of life was assessed by the three level EuroQol instrument (EQ-5D + cognition), in which the domains mobility, self-care, usual activities, pain and discomfort, anxiety and depression, and cognition were included [37]. A summary score ranged from 0 (death) until 1 (full health).

Referral

Participants were provided with flyers of all fall prevention programmes that were available in his or her neighbourhood. Participants received the flyers during the home visit or by post after the telephone call. Information on the flyers consisted of the main aim, content, duration, frequency, number of participants, location and costs of the programme. In addition, information about possible reimbursement of programme costs by health insurances was added. A member of the research team discussed the personal programme preferences, the programmes on offer in participants' neighbourhood and the best matches between the two. After that the participant was given time to decide which programme suited them best. Two weeks later a member of the research team telephoned the participant to enquire whether

the participant had chosen a programme. The participant was free to choose any of the programmes available in the neighbourhood. Once a participant had chosen a programme, a member of the research team initiated the first contact with the local healthcare provider that offered the programme. The healthcare provider then contacted the participant and made an appointment to start the fall prevention programme. In some cases, participants could start straight away (e.g. individual programmes); in other cases, participants received a date when their chosen programme would start in the future (e.g. for group programmes).

Follow-up characteristics

Twelve weeks after the start of the chosen programme, a member of the research team telephoned the participant again and a follow-up questionnaire about participation was administered. Frequent participation was classified as performing exercises of the fall prevention programme daily or a few days a week during the 12-week study period. Infrequent or nonparticipation was classified as performing exercises one day a week, less than one day a week, or not at all. These classifications are described in an earlier publication of the study [34]. Furthermore, experiences with and perceptions of the programme were assessed by multiple choice questions, in accordance with the guideline for medical scientific research in older adults [39]. The questions were based on expert opinions in the research team and can be found in appendix table 1.

Statistical analyses

For baseline and follow-up characteristics, continuous variables were expressed as mean and range, dichotomous variables and preferences were expressed as number and percentage. Differences at baseline between participants with a low and high fall risk were compared using an independent t-test for continuous variables and a chi- squared test for dichotomous variables. In order to determine the correlation between participants in terms of their personal preferences, a two-tailed Pearson correlation was used. To investigate whether there was an association between baseline personal preferences and the presence of the preferences in the programme individuals participated in, Spearman Partial Correlation was performed, adjusted for fall risk. To investigate the association between particular preferences in the chosen program and participation level, logistic regression was applied where the presence of the preferences was used as independent variable and the participation frequency as dependent variable. In order to plot the number of preferences that were eventually present in the fall prevention programme against the follow-up characteristics, an ANOVA test was performed. A distinction was made between participants for which five out of seven or less preferences were present in their chosen programme, six out of seven preferences were present, or all seven preferences were present in the programme. In all analyses a p-value of $<.05$ was considered statistically significant. Analyses were performed using SPSS Statistical Data software (IBM), version 24.

Results

Besides indirect methods (commercials on local television and radio channels), potentially 3100 older adults were reached by recruitment through community nurses, flyers and other direct methods [28]. A total of 222 older adults that met the inclusion criteria were interested in following a fall prevention programme and included in the current study. Due to a dropout of 92 older adults (41%), eventually 129 (59%) indicated that they wanted to start with a particular programme. Older adults that indicated that they wanted to start with a particular programme were younger and they lived independently more often compared to the non-responders, but no difference in fall risk or gender was observed (appendix table 2). In the end, 51% of the older adults started with a programme and 42% of all older adults completed the programme (figure 1). From the start onwards, a total loss of 130 participants was seen. Of them, 25% were lost because the research team could not reach them (telephone not answered, etc.). Of the remaining 75%, reasons for dropout during the process were: older adults had experienced health problems which impeded participation (26%), older adults thought they did not need a fall prevention programme any more (22%), the programmes available during that time did not meet their preferences (12%) or participants had other reasons to dropout (15%).

Baseline characteristics

Baseline characteristics were collected from 137 participants (table 2). The mean age of participants was 80.5 years, most were women, Dutch, lived independently and were widow/widower. Most participants indicated having problems with mobility (73%) and daily activities (64%). Furthermore, 70% of the participants indicated experiencing pain and discomfort. A high fall risk was detected in 64% of the participants. Several differences between participants with a high and low fall risk were observed. Participants with a high fall risk had a lower EQ-5D utility score than those with a low fall risk (0.55 vs 0.71, *p*-value = <.001). In addition, participants with a high fall risk had more problems with mobility (85% vs 52%, p- value=<.001), self-care (52% vs 22%, p-value=.001), and daily activities (78% vs 40%, p-value=<.001) than participants with a low fall risk.

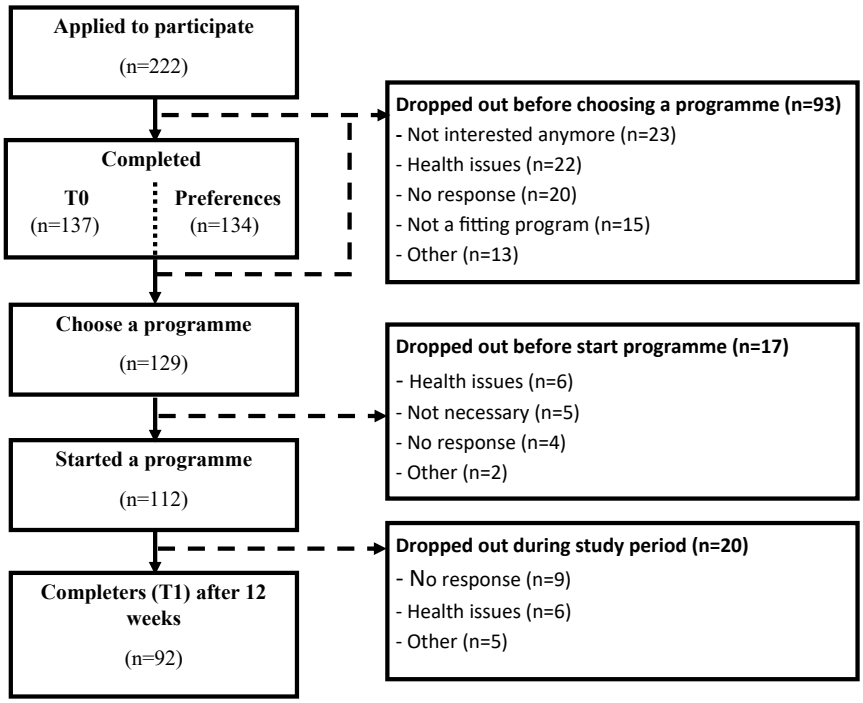

Figure 1. Flowchart.

Table 2. Baseline characteristics (n=137) and differences between high and low risk participants.

Characteristics	Total N = 137 Mean (range)	High risk (64%) N = 87 Mean (range)	No/low risk (36%) N = 50 Mean (range)	P-value T-test
Age	80.6 (65-99)	80.8 (65-99)	80.3 (65-95)	.737
EQ 5D weight score	0.61 (0.13-1)	0.55 (0.13-1)	0.71 (0.18-1)	<.001
	N (%)	N (%)	N (%)	Chi-Square
Gender				.893
Men	32 (23.4)	20 (23.0)	12 (24.0)	
Women	105 (76.6)	67 (77.0)	38 (76.0)	
Country of birth				.019
Netherlands	128 (93.4)	78 (89.7)	50 (100.0)	
Other	9 (6.6)	9 (10.3)	0 (0.0)	
Education				
Low	47 (34.3)	34 (39.1)	13 (26.0)	.121
Middle	67 (48.9)	36 (41.4)	31 (62.0)	.020
High	23 (16.8)	17 (19.5)	6 (12.0)	.256
Living situation				.808
Independent	103 (75.2)	66 (75.9)	37 (74.0)	
Independent with others	34 (24.8)	21 (24.1)	13 (26.0)	
Marital status				
Married	34 (24.8)	21 (24.1)	13 (26.0)	.808
Divorced	9 (6.6)	8 (9.2)	1 (2.0)	.102
Widow/widower	81 (59.1)	52 (59.8)	29 (58.0)	.839
Unmarried	11 (8.0)	5 (5.7)	6 (12.0)	.195
Sustainably living together	2 (1.5)	1 (1.1)	1 (2.0)	.689
Diseases present				
<= 1 diseases	21 (15.3)	8 (9.2)	12 (26.0)	.009
2 diseases	34 (24.8)	18 (20.7)	16 (32.0)	.140
3 diseases	22 (16.1)	16 (18.4)	6 (12.0)	.327
4 diseases	23 (16.8)	16 (18.4)	7 (14.0)	.508
5 or more diseases	37 (27.0)	29 (33.3)	8 (16.0)	.028
Problems with				
Mobility	100 (73.0)	74 (85.1)	26 (52.0)	<.001
Self-care	56 (40.9)	45 (51.7)	11 (22.0)	.001
Daily activities	88 (64.2)	68 (78.2)	20 (40.0)	<.001
Pain/discomfort	97 (70.8)	62 (71.3)	35 (70.0)	.875
Mood	46 (33.6)	32 (36.8)	14 (28.0)	.295
Cognition	45 (32.8)	32 (36.8)	13 (26.0)	.196

Note: An independent t-test was used for continuous variables and a chi-squared for dichotomous variables. A p-value of <.05 is considered statistically significant.

Preferences

Of the 134 participants that completed the preferences questionnaire, 49% specified they preferred a fall prevention programme at home versus 43% that preferred a programme at a location outside their home. An individual fall prevention programme was preferred by 46% versus 44% that preferred the group option. Most participants were willing to pay (51%) for a fall prevention programme, although 41% of the participants indicated that they only wanted to participate in a fall prevention programme if it was free of charge. Some participants did not have a clear preference for one of the two options. An overview of other preferences can be found in figure 2. There was a positive correlation between participants that preferred to exercise at home and individually (r =.769, p- value = <.001). Furthermore, there was a positive correlation between participants that preferred to exercise at an external location and in a group (r = .764, p-value = <.001). When looking at combinations of the preferences 1) at home or at an external location, 2) alone or in a group and 3) only for free or willing to pay, two subgroups can be distinguished. Specifically, 27% of the participants preferred a programme at an external location, in a group, and for a fee whereas another 26% of the participants preferred a programme at home, alone, and free of charge. When comparing participants with a high and a low fall risk, a larger percentage of those with a high fall risk preferred to exercise at home (59% vs 34%, p-value = .006) and alone (56% vs 30%, p-value = .003) than those with a low fall risk. No differences in programme preferences was seen between older adults that started a fall prevention programme compared to those that did not.

Fall prevention programmes

For 31 participants (32%), six out of seven preferences were present, and for 38 participants (40%), all preferences were present in the fall prevention programme they started. Where five or fewer preferences were met, at least four preferences were met for 19 participants (20%) and only for eight participants (8%) three or fewer preferences were met. Eventually the majority of all participants started with an individual-based fall prevention programme (63%), free of charge (63%), at home (53%). When comparing participants with a high and low fall risk, a larger percentage of those with a high fall risk started with an individual-based programme that was free of charge (71% vs 49%, p-value = .014) and at home (61% vs 40%, p-value = .025) than those with a low fall risk. An overview of the fall prevention programmes chosen by participants can be found in table 3.

Table 3. Chosen fall prevention programmes (*n* = 129) and differences between high and low risk participants, exploratory data

Programme	Total (*n* = 129)	High risk (64%) (*n* = 82)	No/low risk (36%) (*n* = 47)	Chi-square
	n (%)	n (%)	n (%)	P-value
In Balance	17 (13.2)	10 (12.2)	7 (14.9)	.788
Falls in the past	16 (12.4)	7 (8.5)	9 (19.1)	.098
Otago / A Matter of balance	13 (10.1)	9 (11)	4 (8.5)	.768
Senior Step	21 (16.3)	13 (15.9)	8 (17)	1.000
Fall analysis	18 (14)	12 (14.6)	6 (12.8)	1.000
Individual physiotherapy	20 (15.5)	17 (20.7)	3 (6.4)	.042
Senior fitness	15 (11.6)	7 (8.5)	8 (17)	.163
Go together	9 (7)	7 (8.5)	2 (4.3)	.485

Note: A p-value of <.05 is considered statistically significant

When comparing the association of personal preference and characteristic of chosen programmes, some preferences showed a moderate to strong association, such as the preferences "at an external location" (*r* = .574, *p*-value = <.001), "at home" (*r* = .529, p-value = <.001) and "in a group" (*r* = .546, p- value = <.001). For the preferences high or low intensity, social or sportive factors and genders mixed, or genders separated, no association was found. Other associations can be found in table 4.

Table 4. Correlations between the baseline personal preferences and the presence of these preference.

Preference	Spearman Partial Correlation	
	Value	Significance
At home	.529	<.001
External location	.574	<.001
Individually	.453	<.001
Group	.546	<.001
Own time	.339	<.001
Fixed time	.306	<.001
Low intensity	.019	.827
High intensity	.042	.636
Social factors	-.143	.108
Sportive factors	.050	.574
For free	.360	<.001
Willing to pay	.294	.001
Gender separate	.045	.616
Gender mixed	.047	.600

Follow-up characteristics

Frequent participation during the study period was indicated by 38% of the participants. Seventy-four percent of the participants indicated that their programme was useful, 52%

that they liked the programme, 55% reported to be more aware of their fall risk, 38% reported an increased confidence in their balance, and 35% of the participants noticed a change in their level of physical activity. In figure 3, the number of preferences that were present in the fall prevention programme is plotted against the follow-up characteristics. A distinction was made between participants that followed a programme in which five or fewer preferences were present, six preferences were present, or all preferences were present in the chosen programme. Participants that participated in a programme in which six of their preferences were present, were more likely to be aware of their fall risk than participants for which less than six or all preferences were present in the programme ($F(2, 58) = 6.452$, p-value = .003). No statistically significant associations were observed between the presence of personal preferences in the programme, and the level of participation in the programme. In addition, no associations were found between the presence of particular preferences and participation level.

Discussion

We found that 49% of participants prefer to exercise at home versus 43% elsewhere, 46% prefer to exercise individually versus 44% in a group, and 41% only want to participate in a programme free of charge versus 51% that is willing to pay. Two subgroups can be distinguished with these preferences, namely a subgroup that prefers a programme outside their own home, in a group and is willing to pay (27%) and a group that prefers a programme at home, alone and is not willing to pay (26%). For 38 (40%) participants, all personal preferences were present in the programme they started. However, no association was found between the number of personal preferences or a particular preference in the programme and participation level.

The personal preferences of the participants in our study varied greatly between individuals. This preference variation between older adults has also been confirmed by a previous study [20]. However, in our study, the majority of participants chose three clear preferences; mixed gender, low intensity, and at fixed times. Even though, in general, the majority of exercise programmes are offered at an external location, the majority of older adults appear to prefer a home-based programme [23–25]. In our study we found that this 'at home' option was more often preferred and chosen among high risk older adults. This difference between older adults at a low and high risk is supported by a study of Dorresteijn et al. in which older adults with a history of multiple falls were more likely to prefer a home-based programme [25]. In our study, 64% of the participants had a high fall risk, which is linked to a history of falls. This highlights a gap between the current offer and the preferences of the most vulnerable community-dwelling older adults. Namely, those of higher age, a lower health related quality of life and a high fall risk. Currently, the evidence-based options for

this population are limited and not widely offered. This problem will probably increase in the coming years due to a larger group of older adults that will continue living at home longer, making it important to meet the preferences of these more vulnerable older adults. This home-based preference of vulnerable older adults is also in line with the preference that older adults in general have about physical activity, namely that they prefer individual activity [40]. A great opportunity for home-based individual fall prevention interventions in the future could be digital interventions, such as tablet, computer or smartphone based applications. Currently studies are still investigating the effectiveness of these programmes on falls. However, considering that these programmes are based on evidence-based exercises it has great potential for future fall prevention [41–43]. Furthermore, we found that more than half of the older adults are willing to pay for an intervention, which is supported by Child et al. who found that older adults are willing to pay as long as it is reasonable [19]. However, 41% still indicate that they will or cannot pay for a fall prevention programme. It is important to consider this population, since costs can be a barrier for participation in fall prevention [23]. Especially for older adults with lower socio-economic status. In order to not increase potential health differences between higher and lower socio-economic status, investments have to be made to create more opportunities free of charge.

In addition to the preferences mentioned, we can distinguish two subgroups when it comes to preferences. These groups account for half of the total cohort which makes it important to create an appropriate offer for these groups. Based on these preferences, there should be a fall prevention programme which can be performed at home, alone and for free and a programme outside the home, in a group and with a possibility for a fee. We already discussed the gap between the more vulnerable older adults and a programme at home, individually and for free. And although evidence-based options for a programme in a group, at an external location and for a fee are available in the Netherlands, also here a gap arises between the programmes on offer and the preferences of the community-dwelling older adults. This problem arises because these programmes are not widely offered throughout different neighbourhoods, which causes poor accessibility. The availability of programmes within older adults' own neighbourhood is important, since transportation problems are an important reason for older adults to reject interventions [16,19]. In order to make these programmes more accessible they should be offered within different neighbourhoods or transportation options should be offered. This requires good coordination between the different health care providers, who sometimes see each other more as competitors, which counteracts their cooperation.

The fact that no associations were found between the presence of personal preferences in the programme and the level of participation could suggest that other factors might be more important. In addition, the preferences participants had did not seem to influence whether they eventually started a programme. This strengthens the impression that other factors

have more influence on participation. Factors such as the social component of a group, a good relationship with the provider or current health status might be more important [44–46]. A review of Bunn et al. showed that factors in fall prevention programmes such as social support and interaction and the idea that a programme is beneficial facilitate participation [22]. Besides, intrinsic motivation could play a more important role in the uptake of fall prevention activities. This reasoning can be supported by the reasons why older adults participate in the first place, namely staying in good health and the fear of becoming vulnerable [18,20]. Furthermore, this intrinsic motivation could also arise from a recent fall or multiple falls in the past, which are associated with a higher uptake of fall prevention programmes [24]. In addition, only 55% of the participants indicate that they liked the programme. Nevertheless, despite not particularly liking it, this group followed the programme for at least 12 weeks, which suggests that for example intrinsic motivation or the belief in positive health outcomes might be more important. Qualitative studies should investigate older adults' reasons for participating in fall prevention. Despite the fact that we found some factors that were associated with the characteristics of chosen programmes, we cannot conclude that these are the most important factors for older adults to participate. In the current study, this association is strongly associated with the available offer of fall prevention programmes during the study period. To find out precisely which factors are most important for older adults, more research is needed, for example through a discrete choice experiment (DCE).

This study provides an overview of the preferences community-dwelling older adults have when it comes to participating in fall prevention programmes. A strength of the study was the participatory design approach, in which community dwelling older adults were involved as part of the research team in each phase of the study. In addition, in the current study more than six out of those seven preferences were present in the fall prevention programme started by 72% of the participants. This was achieved by stimulating healthcare providers to offer as many different programmes as possible in the various neighbourhoods. Nine different programmes were on offer, which increased the chances of a possible 'match'. Because many preferences returned in the fall prevention program, categories of preferences met needed to be changed into seven, six out of seven and five or less preferences met. This was instead of the preferred option, namely, a weak match (1–3 preferences), moderate match (4–5 preference) and a good match (6–7 preferences). Despite this broad offer, some participants were still not able to start a programme matching their preferences during the study period. Which indicates that there is still a gap between older adults preferences and the available fall prevention programmes. This gap caused some drop-out, which is a limitation of the current study.

Of the 222 older adults that applied to participate, 112 individuals finally participated in the study. Most of these were recruited by a community nurse and only a few by self-

identification, reached by flyer or commercials, and therefore we cannot look into the differences in preferences or chosen programmes between different recruitments styles. We did look at different programmes chosen by the participants, but due to the high drop-out, some of the numbers in table 3 are small and therefore these numbers are only exploratory. A reason for drop-out that was often mentioned by older adults was 'poor health', which has been observed in other studies as well [18,20], but also the delay between choosing a programme and the moment the programme started could have resulted in drop-outs among older adults. This sometimes took more than a month. In this period declining health or motivation could have taken place among participants. In addition, sometimes participants' preferences did not match the available offer. This was mainly seen when participants preferred a group based programme but did not want or were not able to pay for it or the programme was not offered within their neighbourhood. This high drop-out could have influenced the results. Furthermore, we classified frequent participation as daily and a few days a week. However, potential reverse effects of daily participation are not taken into account with this classification, based on the little evidence that is available on this topic [47]. Also, how much participants liked the programme and thought it was useful was classified categories while qualitative data on participants experiences and perceptions could have added valuable information to the paper. Moreover, it should be taken into account that data was collected in person as well as by telephone. This difference could have impacted response choices, considering that data collected face-to-face can possibly lead to more socially desirable answers. Lastly, we are only able to make conclusions about this cohort, given that this is a rather old, Caucasian and vulnerable population with a high number of women, which raises the question of generalizability. However, this is a reflection of the older Caucasian race, especially for an older community-dwelling population.

When implementing fall prevention programmes locally, it should be taken into account that preferences can vary greatly between older adults. Local policy makers together with health care providers should arrange applicable programmes for the two largest subgroups, 1) at home, individually and free of charge and 2) outside their own home, in a group with the possibility of a fee. Another aspect that should be taken into account is the preference for a programme free of charge. Despite the fact that most older adults are willing to pay (51%) for a fall prevention programme, still 41% of the older adults are not willing or able to pay. Fall prevention programmes free of charge or completely covered by health insurance are limited, while investing in exercise based fall prevention programmes is cost-effective [48]. To prevent falls among this population it is important to offer a programme free of charge or covered by health insurances. Finally, when targeting adults with a high fall risk, the offer of programmes should mainly focus on individual programmes at home, since this is most preferred by this high risk population. Nevertheless, health care providers and local policy makers have to be careful in adopting to personal preferences of older adults because it is unknown whether programmes remain effective in reducing falls by adopting to these

personal preferences. A review of Sherrington et al. showed that exercise interventions have to consist of specific exercises and a certain intensity-level to be effective [49]. Adopting to personal preferences could be at the expense of these exercises or intensity and thus reduce the effectiveness.

Conclusion

There is a wide range of preferences when it comes to participating in a fall prevention programme. However, there is a large group that prefers a fall prevention programme at home, alone and for free and a large group that prefers a programme outside their own home, in a group and is willing to pay for it. Furthermore, older adults already at high risk for falls prefer an individual programme at home more often. In particular, the preferences location (at home or an external location) and in a group are often found in the programme participants started. However, once older adults start with fall prevention, these preferences seem less important, since there is no association between preferences returning in a programme and participation level.

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Appendix

Table 1. Classification of follow-up characteristics.

Questions	Answers	Classification
Did you got started with the fall prevention programme?	1. Yes 2. No	
How often did you perform actions of the fall prevention programme?	1. Daily 2. Multiple times a week 3. Once a week 4. Less than once a week	Daily or multiple times a week is classified as "Frequent participation". Once a week or less than once a week is classified as "Non-frequent participation".
How much did you like the programme?	1. Not nice at all 2. A little nice 3. Pretty nice 4. Very nice	Not nice at all and a little nice is classified as "Did not like it" Pretty nice and very nice is classified as "Liked it".
How useful did you find the programme?	1. Not useful at all 2. A little useful 3. Pretty useful 4. Very useful	Not useful at all and a little useful is classified as "Not useful". Pretty useful and very useful is classified as "Useful".
Since I have participated in the falls prevention programme, I am more aware of my fall risk.	1. Strongly disagree 2. Disagree 3. Neither agree or disagree 4. Agree 5. Strongly agree	Strongly disagree, disagree and neither agree or disagree is classified as "Disagree". Agree and strongly agree is classified as "Agree".
Since I have participated in the falls prevention programme, I feel myself more secure while standing and walking.	1. Strongly disagree 2. Disagree 3. Neither agree or disagree 4. Agree 5. Strongly agree	Strongly disagree, disagree and neither agree or disagree is classified as "Disagree". Agree and strongly agree is classified as "Agree".
Since I have participated in the falls prevention programme, I exercise more often.	1. Strongly disagree 2. Disagree 3. Neither agree or disagree 4. Agree 5. Strongly agree	Strongly disagree, disagree and neither agree or disagree is classified as "Disagree". Agree and strongly agree is classified as "Agree".

Table 2. Baseline characteristics of responders and non-responders

Characteristics	Total (n=222)	Responders (n=130)	Non-responders (n=92)	P-value
	mean ± SD	mean ± SD	mean ± SD	T-test
Age	79.9 ± 7.2[a]	80.7 ± 7.2	78.7 ± 7.1[b]	.039
	n (%)	n (%)	n (%)	Chi-square
Female	165 (74.3)	100 (76.9)	65 (70.7)	.292
Living alone	156 (70.3)	98 (75.4)	58 (63)	.048
Elevated fall risk	163 (73.4)	98 (75.4)	65 (70.7)	.432

Note: SD: Standard deviation; The fall risk test is determined an elevated fall risk when older adults were fallen in the last 12 months, or had mobility problems and a fear of falling [23]. [a]: n=219, [b]: n=89

9

General discussion

Within this thesis the main aim was to study conditions for successful implementation of prevention programs. Programs on cardiovascular disease prevention in the hospital setting and programs for fall prevention in the hospital and community setting were selected as illustrative examples.

Main findings

Aim 1: Identifying critical conditions for patients and healthcare providers for successful implementation of prevention programs.
Prevention programs executed in familiar healthcare settings or by familiar healthcare providers are crucial for the success of recruiting individuals for prevention programs. To keep healthcare providers as well as participants involved, tailored programs with room for adjustment to need and preferences of participants and participant health status are important.

For successful implementation of prevention programs, recruitment is an important step which can be realized in different settings. For both settings discussed within this thesis (hospital and community), familiarity with the setting or healthcare provider has proved important. In a community setting, as described in chapter 6, the majority of the individuals was recruited by a community nurse. More population broad approaches trough indirect methods like commercials in local media were despite the large reach not successful. An additional advantage of recruitment by healthcare providers is that the individuals reached, already needed care. The need of care and the presence of a clinical condition is often associated with a higher risk of falls and CVD [1,2]. For example, patients with rheumatoid arthritis are more likely to develop CVD [3] and older adults that receive home care are more likely to have problems with movement which is a risk factor of falling [4]. This last advantage of the high risk prevention strategy has already proved important in the hospital setting. Departments with patients that are treated for diseases that are known as underlying risk factor, showed a high percentage of patients at an increased risk (chapter 4).

The effort of involved healthcare providers is important within the recruitment, but also in other steps of implementation. As described in chapter 2 and 5, healthcare providers within the hospital and GPs have a positive attitude towards prevention programs in general. They prefer prevention programs that allow them to draw their own conclusions and to include patients' needs and preferences. A point that is stated as important factor by healthcare providers that participated in the Delphi study described in chapter 6 as well. Besides these factors that have the potential to improve implementation, healthcare providers experience barriers that can impede implementation of prevention programs. Changing routines and resistance to working according protocols together with patients characteristics such as

ethnicity, socioeconomic status and health status are mentioned as barriers. Furthermore, chapter 6 stated that healthcare providers indicate that collaboration between healthcare providers is important to provide prevention.

Besides the effort of healthcare providers, individuals need to be willing and motivated to participate. Their health status is an important factor for participation in prevention programs. On one hand, health problems are one of the main reasons to drop out before the start or during a prevention program (chapter 7 and 8). While on the other hand, the health factors chronic conditions and a high degree of pain, are associated with frequent participation in prevention programs (chapter 3 and 7). Patients that participated in a prevention program report positive about it. In contrast with healthcare providers perceptions, patients do no report that ethnicity or cultural values will impede their participation in prevention programs. Furthermore, they appreciate a short time investment and the idea they can benefit by participating (chapter 2 and 4). In addition, chapter 6 add that emphasizing negative consequences of the risk status and a positive effect of prevention is important in the stimulation towards prevention.

Aim 2a: To evaluate the successful implementation of prevention programs with respect to patients participation in the programs

With a simple and short prevention program the first step towards behavioural change can be taken. However, adherence to the specific advice is challenging and participants are more inclined to take relatively simple actions they can perform themselves.

Within a hospital setting, the majority of the eligible patients was willing to participate in a simple screening program (chapter 4). Following a screening program for identification of fall risk as well as CVD risk, patients are more open to advice, have a more positive attitude towards prevention programs and are more inclined to take action (chapter 2 and 4). However, despite the fact that patients indicate that they are more inclined to take action, there is a wide variation in the number of patients who take action to reduce their risk (chapter 3 and 4). When patients do perform action, it is remarkable that these are self-performed, such as increasing physical activity. Besides that actions are self-performed, it is often not according the tailored advice they received (chapter 3 and 4).

Within a community setting and thus a more population based approach, participation among the individuals reached is much lower. However, when individuals indicated interest in prevention, half of them actually started a prevention program (chapter 6, 7 and 8). In line with actions taken after a hospital screening, self-performed actions that can be executed at home seem easier for individuals to adopt.

Aim 2b: To evaluate the successful implementation of prevention programs with respect to healthcare providers adherence to the programs

Healthcare providers do not always actively initiate prevention in health care. Chapter 5 described that most GPs read the screening results of their patients that were screened in the hospital. However, only one third of the patients had contact with their GP after screening. GPs most often initiated an intervention among smokers to stop smoking. Furthermore, chapter 6 indicates that GPs are not active in enrolling older adults for falls prevention.

Methodological reflections and recommendation for research

Implementation science differs from traditional clinical research. Where traditional clinical research focusses on the health benefits of an intervention, implementation science has a broader scope. Not only patient, but also healthcare provider, political and organizational structures are taken into account [5]. Besides these different outcome levels, interventions have to adopt to different real world settings. That this is a complex process is underlined by the fact that only half of the evidence-based interventions ever reaches extensive clinical use [6]. Several studies in different health domains estimated that, the process from evidence-based intervention towards clinical practice, takes on average 17 years [6,7]. A quicker transfer from scientific evidence into better health outcomes for patients is wanted, however still much is unknown in understanding and managing these time lags [7].

Monitor adaptations to understand effectiveness in a real world setting

To investigate implementation, the natural context of a setting should be preserved as much as possible. However, it is unlikely that an intervention that entails changes in clinical practice can be implemented without assistance and therefore interference in the natural setting [8]. Often researchers try or need to optimize the setting. Within this thesis, by implementing a screening program within the hospital, in some departments assistance to recruit patients was necessary (chapter 2 until 5). This has both the potential to have increased or reduced the uptake of the intervention. For both cases it is questionable what this means for the validity [5]. On the other hand, not optimizing the natural setting will lead to disadvantages as well. That the setting is uncontrolled makes it hard to draw solid conclusions. For example, a variety of approaches by different healthcare providers could arise. And despite that effect on patients' health status is not the main goal of implementation studies, there may be a drop in effectiveness if an evidence-based intervention is moved from a research setting to a real world setting. Especially because often interventions have to adopt to such real world settings [5]. Within fall prevention in the community, some evidence-based interventions were adjusted by the physiotherapist. This was in order to make programs more accessible and less intensive for older adults. These adjustments might have had an effect on the effectiveness when it comes to preventing falls. However, these adaptations

are not automatically failures of implementation, but need to be monitored in order to understand the effect of different modifications [9]. It is important to investigate to what extent evidence-based interventions retain their effectiveness after implementation outside a research setting. Alongside, journals and reviewers should take into account this potential drop in effectiveness. When considering implementation studies, they should not compare these results of effectiveness with clinical studies.

Use consistent frameworks to describe implementation

The many outcome levels and the different settings make it difficult to come up with a framework to measure implementation outcomes for different settings. Despite that over the years, more and more consensus is reached about determinants that predict implementation outcomes, still many different frameworks exist and are used. Durlak and DuPre examined 500 studies with existing frameworks to measure implementation and determined that structural, organizational, provider and innovation level determinants affect implementation outcomes [9]. A review of Chaudoir et al. added a patient level and found 62 measures that cover one of these determinants [10]. The only measure that covers all these determinants is the Barriers and Facilitators Assessment Instrument of Peters et al. [11] which is used within the studies in this thesis. Although we used a comprehensive framework for determinants of implementation in this thesis, comparing different implementation strategies remains difficult.

Provide both long-term and short-term follow up in measuring behavioural change

Behavioural change is complex and hard to reach [12]. Therewith, also measuring this change is difficult in describing the success of the implementation. We measured individuals own initiatives after only interfering slightly in their lives. Despite the positive attitudes regarding prevention, there were great variations in individuals that took preventive actions. Notably, actions are mainly characterized by what patients think they need and fit in their lives instead of adhering to given advice. This often takes more effort and requires behavioural change, which involves many stages and is influenced by multiple factors [13,14]. The theory of planned behaviour states that behaviour arises from the intention to display this behaviour. This intention is influenced by attitude, subjective norms and perceived behavioural control [13]. In older adults is has been shown that it can even predict physical activity levels after a period of three years [15]. The positive attitudes toward prevention found after screening in the hospital has the potential to lead to behavioural change later in life, perhaps triggered by other factors or life events. Therefore, when measuring short-term effects, for measuring behavioural change, also long-term effects should be taken into account.

Societal impact

To create societal impact interaction with societal stakeholders is needed, studies should be relevant to social economic developments and results should be used [16]. An advantage of studies in real world settings is that these already have the potential of a greater public health impact than studies in clinical settings [17]. Within the studies in this thesis, relevant stakeholders were involved by offering fall prevention programs in the community. Programs were organized by local stakeholders for the local community. To ensure results could be used among stakeholders, they were informed about the study results by newsletters and information was shared on conferences with non-scientific attendees like physiotherapists. In addition, for the in-hospital studies, relevant stakeholders participated as well. Not only medical specialists and nurses at the departments but also GPs of patients who are normally involved in the prevention process were involved. Besides, for these studies a model was created for the prevention of CVD and falls. This could be implemented in other departments, but also within other hospitals to create more impact.

Recommendations for policy

Highlight the importance of prevention

The importance of prevention and the belief of positive health outcomes by preventive actions needs more attention. Currently, the belief that lifestyle change is only essential if risk is already raised undermines the core of prevention programs [18]. The national prevention agreement is a great development in highlighting the importance of prevention at policy level [19]. The agreement is mainly aimed at a population approach, where the whole population is stimulated to adopt healthy behaviour [20]. A great advantage of this approach is that it has the potential to decrease the presence of multiple lifestyle diseases. One of the main pillars, “a smoke-free generation” (in Dutch: rookrvrije generatie) aims to ensure that less than 5% of the Dutch adult population smokes in 2040. Besides the decrease in CVD this also will lead to a decrease in type II diabetes, cancer and chronic obstructive pulmonary disease (COPD). Based on previous insights in CVD prevention, Geoffrey Rose argued already in 1992 for this population approach, since conditions will arise among those not at risk [21]. Nevertheless, this approach has different downsides. It requires political changes which often takes many years due to difficult political barriers [22]. In view of the promises within the prevention agreements, this is also shown by an evaluation of the behaviour of supermarkets. Two years after the prevention agreement, supermarkets are not living up to their promises to encourage customers to eat healthier [23]. Furthermore, the population approach contributes much to population health, but only a little to individuals health, especially short-term [24]. This so called prevention paradox is no great incentive for change for the individual [25]. This, in combination with

the fact that behavioural change is already hard, highlights the advantages of a more high risk approach of prevention. Uptake of interventions aimed at those at risk will be higher since they benefit more from behavioural change [21]. For prevention of CVD this high risk approach can be an essential addition to the population approach [26]. That being said, for screening programs it is crucial that focus is not only on the group with an increased risk, but also on patients who do not appear to have an increased risk. For them, adaptation to a healthy lifestyle is important as well to maintain their low risk status. For fall prevention, strategies often aim at behavioural change like increasing physical activity, which is an intensive process that requires intrinsic motivation [27,28]. But also other prevention strategies require behavioural change like adjustments in and around the house or changing medication [29,30]. Since most older adults do not see fall prevention as something they need [31], risk identification and a high risk approach of fall prevention is recommended.

Broaden the prevention agreement

As mentioned, the current agreement has the potential to decrease the incidence of CVD. However, this prevention agreement solely focusses on smoking, obesity and alcohol consumption in which youth is the main target group. For older adults important topics like dementia, loneliness and fall prevention are not discussed [19]. A broader scope would represent the intentions of the Dutch Ministry of Health, Welfare and Sport, to allow older adults to live at home for as long as possible. Living at home longer and staying in good health are also important topics for older adults themselves. Prevention strategies within older age categories should therefore focus on individuals needs and health status and the positive health outcomes by prevention programs. This not only will contribute to the intentions of the Dutch Ministry, but has also the potential to reduce high costs of fall incidents [32].

Recommendations for practice

Increase awareness of patients on prevention by in-hospital screening programs

In a community setting it is hard to reach individuals for prevention programs. Hospital settings can be an important location to reach individuals for a more high risk prevention approach. Most patients are willing to participate in a simple screening program. Therefore, it is important to provide simple and effective screening instruments. Since time investment is a common barrier for implementation among as well healthcare providers as individuals at risk. Furthermore, not every department is suitable and not for every department screening will be beneficial. Therefore, it is important to focus on departments with potential high risk patients. Patients treated for diseases which are known as underlying risk factors are potentially an important target group to detect and prevent individuals for a chronic condition like CVD. According to the National Institute for Public Health and the

Environment, in addition to personal and lifestyle factors, some diseases are a risk factor for developing CVD. Among others COPD, chronic kidney disease due to reduced filtration through the kidneys, and inflammatory bowel disease such as Crohn's disease and ulcerative colitis are mentioned [33]. Reaching these individuals within the healthcare setting, well-known to them, has the potential to be the first step in a high risk prevention strategy and can create a more positive attitude towards prevention.

Empower healthcare providers in offering prevention by collaboration

Many evidence-based fall prevention programs can be offered in a community based setting. However, many older adults are unaware of their risk [31] and besides not aware of available prevention programs within their neighbourhood [34]. Also, transportation problems and costs of a fall prevention program can be barriers for older adults to participate. The complexity of implementing fall prevention programs in a community setting requires an approach in which several disciplines have to work together. To make fall prevention programs accessible to as many older adults as possible, physiotherapists and occupations therapists have to work together in offering different fall prevention activities at different locations. In addition, the municipality, the government and health insurance companies must contribute in order to keep fall prevention affordable. In view of the aging population who have to live at home longer, the high costs associated with fall accidents and the proven cost-effectiveness of fall prevention, investing in fall prevention and in collaboration is an important step in preventive care for older adults

In prevention of CVD there is an important role for the GP. With screening patients in an in-hospital setting, tasks regarding prevention were more divided. However, the GP was still responsible for follow-up and can use this role more actively. Nevertheless, by doing this, they must be supported by other healthcare providers. Despite that GPs indicate they feel educated enough for their role as preventive care giver, the ability to guide patients towards behavioural change is often seen as a barrier. Other healthcare providers like the practice nurse, but also dieticians can play an important role here.

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Summary

General introduction

Lifestyle determinants, such as physical inactivity, together with the aging population leads to a high prevalence of CVD and fall incidents. Despite the ever-growing emphasis on prevention and the existing evidence based interventions for CVD as well as fall prevention, implementation remains difficult. The main focus of this thesis is to study conditions for successful implementation of prevention programs. Programs on cardiovascular disease prevention in the hospital setting and programs for fall prevention in the hospital and community setting were selected as illustrative examples. The aims of this thesis were:

1) To identify the critical conditions for patients and healthcare providers for successful implementation of prevention programs within healthcare
2) To evaluate the successful implementation of prevention programs with respect to:
    a) Patients participation in the programs
    b) Healthcare providers adherence to the programs

The aims will be answered for the two types of settings were prevention is integrated is someone's daily life. Part I describes the implementation during regular visits to the hospital and part II evaluates the implementation within older adults living environment.

Part I: Implementation of prevention programs in an in-hospital setting

Chapter 2 describes patients as well as healthcare providers perceptions of an in-hospital fall risk screening among patients ≥70 years at the emergency department and the neurologic outpatient clinic. Patients reported no single barrier regarding the screening. They especially reported positive about the small time investments they had to make, that they expected to benefit from the program and that the program was concordant with culture and/or values. At 3-month follow-up patients indicated to be more open to prevention advice and to have a more positive attitude towards fall prevention. Despite that healthcare providers reported factors as supportive staff and attractiveness of the programs as helpful in implementing the program, they were less positive than the patients. Healthcare providers involved in the screening reported patients cooperation, their own involvement and resistance to working according protocols as barriers. Healthcare providers involved in continuation of preventive care were more positive but reported problems with changing routines, working according protocols and their own involvement as barriers. **Chapter 3** continues by describing actions the same patients take three months after participating in the fall risk screening. Of the 20 high risk patients that received a tailored prevention advice, 70% took action to prevent falls. Mainly actions without help of a healthcare provider were taken (30.1%), specifically strength and balance training was most often performed (12%). Furthermore, an association was found between the presence of chronic conditions and taking action after the screening.

In chapter 4, patients perspectives and actions after an in-hospital CVD risk screening are described. Patients were screened on 10years risk of developing or aggravating CVD at the rheumatology (primary prevention) and vascular surgery (primary prevention) department. Again, no barriers were experienced by patients, and they reported positive about the time investment, the expectation to benefit and the concordance with culture and/or values. At 3-month follow-up patients reported to be more open to prevention advice and have a more positive attitude towards CVD prevention. Of the patients with a high or very high risk and with modifiable risk factors, 24.2% took action to reduce risk. They most often increased physical activity (10.8%) followed by a healthier diet (9.9%). **In chapter 5**, perspectives of general practitioners and actions they take after an in-hospital CVD risk screening are described. Patients screening results together with a survey was sent to patients GPs'. Especially their own education as preventive care giver and that the program leaves enough room for own conclusions were mentioned as facilitator by GPs. Barriers to implementation of prevention programs were reported in the patient characteristics ethnicity, number of patient contacts and patients financial status. Of the 96 patients with a high or very high risk an appointment with the GP was realised for 41 (42.7%) patients and 14 (14.6%) initiated an intervention among their patients. GPs most often initiated a smoking cessation intervention among smokers.

Part II: Implementation of prevention programs within a community setting

Chapter 6 describes the implementation of a home-based fall prevention program among older adults (≥65 years) using the RE-AIM framework. The implementation process consisted of dialogues with healthcare providers and older adults, the development of an implementation protocol, recruitment of participants, program implementation and evaluation. The study found that in recruiting participants for fall prevention, community nurses are important as well as collaboration between different healthcare providers. During the program, taking into account participants' needs and preferences and emphasizing negative consequences of the risk status and a positive effect of prevention is important in stimulation towards prevention. Which factors are associated with frequent participation of older adults in a home-based fall prevention program are discussed in **chapter 7**. It showed that drop-outs were mainly seen because of health problems. Fifty-two percent of participants frequently participated, meaning they performed exercise daily or a few days a week. A high degree of pain was associated with frequent participation in the program. In **chapter 8**, personal preferences of older adults in participating in fall prevention were assessed and nine different fall prevention programs were offered to participants. After 12 weeks, participation in the programs were assessed by survey. Health problems were the main reason to drop-out before or during the intervention. Results showed that 38% frequently participated in the programs. Nevertheless, the presence of preferences or the extent to which the program matched preferences was not associated with participation.

General discussion

The main aim was to study conditions for successful implementation of prevention programs. This thesis showed that the use of familiar healthcare settings or familiar healthcare providers was crucial for the success of recruiting individuals for prevention. To keep both involved, programs with room for adjustments to needs and preferences of participants and participant health status has proved important. Furthermore, this thesis described that simple and short programs can be a first step towards behavioural change. However, for adherence to advice and actual behavioural change more intensive interventions and collaboration among healthcare providers in necessary.

We recommend policy to highlight the importance of prevention. Where for fall prevention a high risk approach is recommended for CVD prevention this is important addition to a population approach. Therewith, fall prevention needs more attention nationally, in for example the prevention agreement. In practice, awareness among patients at risk could be raised with in-hospital screening instruments. However, for follow-up in providing preventive care, there should be a shared responsibility of several healthcare providers and collaboration between healthcare providers should be accomplished.

Samenvatting

Algemene introductie

Leefstijl determinanten, zoals fysieke inactiviteit, roken en het gebruik van alcohol hebben samen met de vergrijzing een aanzienlijk aandeel in de totale ziektelast van Nederland. De hoge prevalentie van deze risicofactoren leidt derhalve tot een hoge prevalentie van hart- en vaatziekten en valongevallen. Ondanks de groeiende aandacht voor preventie en de vele effectief bewezen preventieprogramma's, blijft de implementatie van deze programma's complex. Het doel van dit proefschrift is om de voorwaarden voor succesvolle implementatie van preventieprogramma's te onderzoeken. Hiervoor zijn programma's voor de preventie van hart- en vaatziekten in het ziekenhuis en valpreventieprogramma's in het ziekenhuis en in een wijksetting geselecteerd. De doelstellingen van dit proefschrift zijn:

1) Het vaststellen van essentiële voorwaarden voor zowel patiënten als zorgverleners voor succesvolle implementatie van preventieprogramma's in de gezondheidszorg;
2) De succesvolle implementatie van preventieprogramma's evalueren met betrekking tot:
    a) Deelname van patiënten aan de programma's
    b) Het opvolgen van de programma's onder zorgverleners

Preventieprogramma's in de huidige leefomgeving van het individu zijn ingezet om deze doelstellingen te beantwoorden. Deel I beschrijft de implementatie tijdens gebruikelijke zorg in het ziekenhuis en deel II evalueert de implementatie in de woonomgeving van ouderen.

Deel I: De implementatie van preventieprogramma's binnen het ziekenhuis

Hoofdstuk 2 beschrijft ervaringen van zowel patiënten als zorgverleners met het screenen op valrisico binnen het ziekenhuis. Het risico om te vallen werd getest bij patiënten van ≥70 jaar die de spoedeisende hulp of polikliniek neurologie bezochten. Deelnemende patiënten rapporteerden geen enkele barrière als het gaat om screenen op valrisico in het ziekenhuis. Ze rapporteerden voornamelijk positief over de geringe tijdsinvestering die ze moesten maken voor de screening, dat ze verwachtten baat te hebben bij de screening en dat het programma in overeenstemming was met hun eigen cultuur en/of waarden. Drie maanden na de screening gaven patiënten aan dat ze meer open stonden voor advies en een positievere attitude hadden tegenover valpreventie. Zorgverleners waren minder positief dan patiënten. Wel vonden zij ondersteuning van personeel bij screening voldoende en de lay-out van het programma handig in gebruik. Echter rapporteerden zorgverleners het niet meewerken van patiënten, het niet hebben ingelezen en onthouden van het protocol en de weerstand tegen het werken volgens protocollen als belemmering voor de implementatie. Huisartsen die betrokken waren bij het voortzetten van de preventieve zorg waren positiever over het implementeren van het screeningsprogramma dan hun collega's in het ziekenhuis.

Evenwel rapporteerden zij het aanpassen aan veranderende routines, weerstand tegen het werken volgens protocollen en het inlezen en onthouden van het protocol als belemmerend voor implementatie. In **hoofdstuk 3** wordt beschreven welke acties patiënten die getest zijn op valrisico ondernemen naar aanleiding van een screening in het ziekenhuis. Drie maanden na de screening had 70% (14/20) van de patiënten met een hoog valrisico actie ondernomen om een val te voorkomen. Dit werd voornamelijk gedaan zonder de hulp van een zorgverlener (30.1%) en bestond meestal uit kracht- en balansoefeningen (12%). Daarnaast werd er een positieve associatie gevonden tussen de aanwezigheid van chronische aandoeningen en het ondernemen van actie.

In **hoofdstuk 4** wordt het perspectief van patiënten en de preventieve acties die zij ondernemen na deelname aan een screening op hart- en vaatziekten beschreven. Patiënten op de reumatologie (primaire preventie) en vaatchirurgie afdeling (secondaire preventie) werden getest op het 10-jaars risico op het ontwikkelen of verergeren van hart- en vaatziekten. Er werden geen barrières gerapporteerd door patiënten. Daarnaast waren ze positief over de tijdsinvestering, verwachtten ze baat te hebben bij de screening en vonden ze het vroeg opsporen van ziekten niet in strijd met hun eigen cultuur en/of waarden. Tot slot rapporteerden patiënten drie maanden na de screening dat ze meer open stonden voor advies en een positievere houding hadden tegenover preventie van hart- en vaatziekten. Daarnaast had 24.2% (54/223) van de patiënten met een hoog risico en beïnvloedbare risicofactoren actie ondernomen om het risico te verlagen. Meestal verhoogden patiënten hun fysieke activiteit (10.8%) gevolgd door het toepassen van een gezonder dieet (9.9%). **Hoofdstuk 5** beschrijft welke acties huisartsen ondernamen nadat hun patiënten in het ziekenhuis waren gescreend op het 10-jaars risico op het ontwikkelen of verergeren van hart- en vaatziekten. De uitslag van de screening, samen met een vragenlijst werd naar de huisartsen gestuurd. Bij 62% (96/155) van de patiënten werd een hoog risico op het ontwikkelen of verergeren van hart- en vaatziekten vastgesteld. Voor 41 (42.7%) van deze hoog-risicopatiënten werd een afspraak gerealiseerd en voor 14 (14.6%) patiënten werd een interventie gestart op initiatief van de huisarts. Het vaakst werd dit gedaan middels een stoppen met roken interventie.

Deel II: De implementatie van preventieprogramma's binnen de woonomgeving

Hoofdstuk 6 beschrijft middels het RE-AIM model de implementatie van een thuis aangeboden valpreventieprogramma onder ouderen (≥65 jaar). Het implementatieproces bestond uit gesprekken met zorgverleners en ouderen, het ontwikkelen van een implementatieprotocol, werving van deelnemers, het implementeren van het programma en de evaluatie ervan. De interventie bestond uit een 12 weken durend oefenprogramma met balans- en krachtoefeningen die ouderen thuis konden uitvoeren. De studie toonde aan dat de inzet van wijkverpleegkundigen evenals een goede samenwerking tussen zorgverleners

belangrijk zijn bij de werving van ouderen voor valpreventieprogramma's. Daarnaast gaven zorgverleners aan dat met het organiseren van valpreventie in een wijkgerichte setting, het rekening houden met behoeften en voorkeuren van deelnemers belangrijk is. Ook het benadrukken van de negatieve gevolgen van de risicostatus en het positieve effect van preventie was belangrijk in het stimuleren van individuen richting valpreventie. In **hoofdstuk 7** wordt beschreven welke factoren samenhangen met frequente deelname van ouderen aan een valpreventieprogramma dat bij hen thuis wordt aangeboden. Daaruit bleek dat uitval voor of tijdens het programma vooral werd veroorzaakt door gezondheidsproblemen. Tweeënvijftig procent van de deelnemers deed frequent, dagelijks of een paar dagen per week oefeningen voor het programma. Tot slot werd er een samenhang gevonden tussen een hoge mate van pijn en frequente deelname aan het programma. In **hoofdstuk 8** worden voorkeuren van ouderen met betrekking tot het volgen van valpreventie beschreven. Daarvoor werden negen verschillende valpreventieprogramma's aangeboden aan ouderen (≥65 jaar) binnen Breda. Onderzocht werd of specifieke voorkeuren of het terugkomen van voorkeuren in programma's invloed had op de participatie van deelnemers. Twaalf weken na de start van het programma werd deelname aan het programma uitgevraagd. Problemen met de gezondheid was de belangrijkste reden om van deelname af te zien. Eenmaal gestart met een programma nam 38% frequent deel aan het programma. De aanwezigheid van voorkeuren of de mate waarin het programma overeenkwam met de vooraf aangegeven voorkeuren was niet geassocieerd met deelname aan het programma.

Algemene discussie

Het doel van dit proefschrift was om de voorwaarden voor succesvolle implementatie van preventieprogramma's te onderzoeken.

Dit proefschrift toont aan dat het gebruik van vertrouwde zorginstellingen en/of vertrouwde zorgverleners cruciaal is voor een succesvolle werving van deelnemers voor preventieprogramma's. Om zowel deelnemers als zorgverleners betrokken te houden zijn er programma's nodig waar ruimte is voor aanpassingen naar de behoeften en voorkeuren van deelnemers. Daarnaast blijkt voor patiënten de huidige gezondheidstoestand een belangrijke factor om af te zien van deelname. Tevens is er een hogere en frequentere deelname te zien onder deelnemers met respectievelijk chronische ziekten en een hoge mate van pijn. Verder beschrijft dit proefschrift dat eenvoudige en korte programma's een eerste stap kunnen zijn richting gedragsverandering. Echter, voor naleving van gegeven advies en daadwerkelijke gedragsverandering zijn er intensievere programma's en samenwerking tussen verschillende zorgverleners nodig.

Naar aanleiding van dit proefschrift raden wij de politiek aan om het belang van preventie te benadrukken. Voor valpreventie wordt een strategie aanbevolen die zich richt op een bevolkingsgroep met een hoog risico. Daarbij behoeft valpreventie landelijke aandacht,

bijvoorbeeld binnen het preventieakkoord. Binnen de preventie van hart- en vaatziekten kan het richten op een hoog-risicogroep zorgen voor een belangrijke aanvulling op een preventiestrategie gericht op de gehele bevolking, zoals in het huidige preventieakkoord. In de praktijk zou het bewustzijn van individuen met een verhoogd risico verhoogd kunnen worden middels screeningsinstrumenten in het ziekenhuis. Echter, om de continuïteit van preventieve zorg te waarborgen, moet er onder zorgverleners gedeelde verantwoordelijkheid zijn. Tot slot is het verder ontwikkelen van de samenwerking tussen deze zorgverleners van belang voor optimale preventieve zorg.

List of publications

This thesis

Barmentloo LM, Dontje ML, Koopman MY, Olij BF, Oudshoorn C, Mackenbach JP, Polinder S, Erasmus V. Barriers and Facilitators for Screening Older Adults on Fall Risk in a Hospital Setting: Perspectives from Patients and Healthcare Professionals. International Journal of Environmental Research and Public Health 2020, 17(5): 1416.

Barmentloo LM, Erasmus V, Olij BF, Haagsma JA, Mackenbach JP, Oudshoorn C, Schuit SCE, van der Velde N, Polinder S. Can fall risk screening and fall prevention advice in a hospital setting prompt older adults patients to take action to reduce their fall risk? Accepted by Journal of Applied Gerontology.

Barmentloo LM, Erasmus V, Dontje ML, Boogaard L, Krijgsman I, Mackenbach JP, Verhagen HJ, Karels S, Hazes M, Sijbrands EJG, Roeters van Lennep JE, Polinder S. Implementation of cardiovascular disease screening as preventive care in a hospital setting: A patient perspective. Submitted.

Barmentloo LM, Erasmus V, Boogaard L, Bun V, Bindels PJE, Mackenbach JP, Polinder S. What facilitates general practitioners follow-up after in-hospital cardiovascular risk screening? Submitted.

Olij BF, Erasmus V, Barmentloo LM, Burdorf A, Smilde D, Schoon Y, van der Velde N, Polinder S. Evaluation of implementing a home-based fall prevention program among community-dwelling older adults. International Journal of Environmental Research and Public Health 2019, 16(6): 1079.

Olij BF, Barmentloo LM, Smilde C, van der Velde N, Polinder S, Schoon Y, Erasmus V. Factors associated with participation of community-dwelling older adults in a home-based falls prevention program. International Journal of Environmental Research and Public Health 2019, 16(6): 1087.

Barmentloo LM, Olij BF, Erasmus V, Smilde D, Schoon Y, Polinder S. Personal preferences of participation in fall prevention programmes: a descriptive study. BMC Geriatrics 2020, 20(1): 185.

Other publications

Bronner MB, Haagsma JA, Dontje ML, Barmentloo LM, Kouwenberg RMCEJ, Olde Loohuis AGM, de Groot A, Erasmus V, Polinder S. Long-term impact of a Q-fever outbreak: An evaluation of health symptoms, health-related quality of life, participation and health care satisfaction after ten years. Journal of Psychosomatic Research 2020, 139: 110258.

PhD portfolio

Name PhD student: Lotte Barmentloo
Department: Public Health
PhD period: August 2017-Augustus 2020
Promotor: Prof.dr.ir. A. Burdorf
Copromotoren: Dr. S. Polinder, Dr V. Erasmus
ECTS: 33.3

PhD training	Year	ECTS
General courses		
Ergo coach	2018	0.3
Basisdidactiek voor docenten (TtT I)	2018	1.0
Ontwerpen van vragen voor schirftelijk tentamens	2018	0.3
NIHES – Introduction to Data-analyses	2018	1.0
NIHES – Methods of Public Health Research	2018	0.7
Systematic Literature Retrieveal (in Pubmed) 1 & 2	2019	0.4
EndNote workshop	2019	0.2
Hoe ontwikkel ik een e-module	2019	0.3
Scientific Integrity	2019	0.3
BROK	2020	1.2
Conferences, seminars and symposia		
Department of Public Health seminars	2017-2020	2.5
Symposium GENERO	2017	0.2
SRZ congress safety and quality	2017	0.2
National fall symposium	2018-2019	0.4
NVMO congress	2018-2019	0.4
FNO national congress	2019	0.2
Health Science Research Day	2019	0.2
Presentations		
GENERO steering group	2017	1.0
Section meeting	2018	1.0
Department of Public Health research seminar	2018-2019	2.0
Department of Public Health staff meeting	2019	1.0
FNO national congress	2019	1.0
National fall symposium	2019	1.0
NVMO congress	2019	1.0
Teaching		
Supervising student patients shadowing	2017-2020	3.0
Lecturing ‘VO Leefstijladvisering’	2018-2020	3.0
Lecturing ‘VO Gezondheidsvoorlichting’	2018-2019	2.0
Reviewing bachelor essays	2019	1.0
Supervising community projects	2019-2020	2.0
Lecturing ‘VO Shared Decision Making’	2019-2020	2.0
Supervising Master’s internship and thesis (Avans+)	2020	0.5
Supervising community project 2.0	2020	1.0
Reviewing COVID-19 essays	2020	1.0

About the author

Lotte Barmentloo was born on July 24th, 1992 in Groningen, the Netherlands. She completed high school in 2009 at the CS Vincent van Gogh in Assen. After high school she started her bachelor Sports, Health and Management at Hanzehogeschool Groningen of which she obtained her bachelor's degree in 2013. After a transition year with classes of the Open University and Maastricht University, she started her master Human Movement Sciences at Maastricht University in 2014. In 2015 she obtained her master's degree with a master thesis about the SamenLangerGezond lifestyle intervention. Within this study, she researched the effect of the intervention on the metabolic syndrome in women with and without a migration background. In 2017 she started at the department of Public Health of the Erasmus Medical Center in Rotterdam. At the department she was involved in different research projects on fall prevention and cardiovascular disease prevention which resulted in this thesis. In addition to her work as a junior researcher for the department she was active as a scientific educator for the study of medicine. As educator she was involved in setting up new classes and providing classes on lifestyle, patient centered care and social involvement.

Lotte Barmentloo werd op 24 juli 1992 geboren in Groningen, Nederland. Ze behaalde haar middelbareschooldiploma in 2009 aan het CS Vincent van Gogh te Assen. Na het afronden van de middelbare school startte ze haar bachelor Sport, Gezondheid en Management aan de Hanzehogeschool Groningen waarvoor ze in 2013 haar bachelor behaalde. Na een schakeljaar waarin ze vakken van zowel de Open Universiteit als Maastricht University volgde, startte ze in 2014 haar master Human Movement Sciences aan Maastricht University. In 2015 haalde ze haar masterdiploma met een master thesis over de SamenLangerGezond leefstijlinterventie. Binnen deze studie onderzocht ze het effect van de interventie op het metabool syndroom bij vrouwen met en zonder migratieachtergrond. In 2017 startte ze bij de afdeling Maatschappelijke Gezondheidszorg van het Erasmus Medisch Centrum te Rotterdam. Op de afdeling was ze betrokken in verschillende onderzoeksprojecten op het gebied van valpreventie en hart- en vaatziekten preventie, wat resulteerde in dit proefschrift. Naast haar werk als junior onderzoeker was ze voor de afdeling actief als wetenschappelijk docent binnen het geneeskundeonderwijs. Als docent was ze betrokken bij het ontwikkelen en uitvoeren van vakken op het gebied van leefstijl, patiëntgerichte zorg en maatschappelijke betrokkenheid.

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