

Online supporting information Document S1. Functional training program

Article title: Blended home-based exercise and dietary protein in community dwelling older adults: a cluster RCT.

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Functional training program – VITAMIN study

The home-based personalized exercise training program (VITAMIN-program) is a functional training program with an additional general physical activity plan. This VITAMIN-program is developed by the Amsterdam University of Applied Sciences (AUAS) based on the Functional Training for older adults by TNO Research (The Netherlands), expertise on physiotherapy and exercise therapy, expertise on exercise training for older adults and focus group discussions with older adults and their trainers (Mehra et al. 2016 & Mehra et al. 2018).

Functional exercises

This functional training program consists of functional exercises focusing on daily activities which are important for independent living and those that are related to first disabilities (e.g. walking stairs, lifting groceries, chair rising). The training will be performed in the home environment and the training itself is a combination of cognition, perception and mobility and adapted to the dynamic environment of this individual (de Vreede & van Meeteren 2008). Within our home-based exercise program older adults can select their most important daily activities and which activities they want to maintain and/or improve. Based on their own set goals and preferences they are able to design their personalized functional training program. This personalization is incorporated to tailor training dimensions to a personal setup; type of exercise, level of exercise, duration, sets, and complexity. In addition, this supports the self-pacing of their progression and self-regulation during the intervention.

Goals

Primary

To improve physical functioning during daily activities of older adults with chronic health conditions and starting physical impairments.

Secondary

To improve an active lifestyle of older adults with chronic health conditions and starting physical impairments.

Training principles

Training frequency, time and intensity

Incorporating every day activity in daily life is desirable for older adults. Previous activity guidelines reported a requirement of a minimum of 150 minutes moderate intensity per week. With moderate- to vigorous- intensity the respiration, heart rate and transpiration increases. The recommended strategy was to engage in 30 minutes exercise sessions for at least 5 days per week. (Nationaal Kompas Volksgezondheid 2014, Wojtek & Chodzko-Zajko 2013, Nelson et al. 2007).

The purpose of our training is to experience the training intensity as moderate to vigorous. (rate of perceived exertion 5-6 to 7-8 on the 10 point scale). This could start with 10 minute exercise bouts. During progression over time prolonging of exercise sessions up to 45 minutes was recommended to support the cardiorespiratory advantages.

Our recommendation is to execute the functional exercise training program for at least 2 times a week. The inclusion criterium of our study is participating in a community based weekly exercise program. If older adults perform once weekly exercise training, the functional training program needs to be executed for a minimum of 2 times a week; resulting in a total of 3 sessions a week.

Compared to the previous activity guidelines the new physical activity guidelines (Dutch Health Council, 2017) emphasize the importance of muscle-strengthening activities on two or more days a week and balance exercises for the older adults. With this functional training program these important exercise requirements for older adults can be incorporated. In the upcoming paragraphs the personalization and intensity is further explained.

Domains

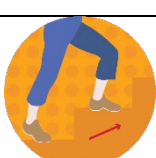
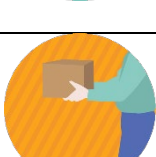
We have transferred the ideally exercise prescriptions for older adults; aerobic exercise, muscle strengthening exercises, flexibility and balance exercises into four physical functioning domains. (Wojtek & Chodzko-Zajko 2013, Nelson et al. 2007). They show similarities with the English concept of “5 basic S’s of training and performance”, e.g. stamina, strength, speed, skill en suppleness (Dick et al. 1985).

- Domain 1. Strength (strength in torso and extremities)
- Domain 2. Endurance (cardiorespiratory fitness)
- Domain 3. Suppleness (flexibility and range of motion of torso and extremities)
- Domain 4. Balance and coordination (neuromotor skills)

Functional training exercises library

These four physical functioning domains are expressed in different combinations within the five categories of daily living activities. This Table 1 projects 5 categories of daily activities, the underlying 17 types of exercises and their levels (A, B and C) as well as the basic starting positions. For the older adults, the first step in personalization is the ability to choose from 3 levels of exercise (A, B, and C) per type of exercise. For all these exercises a description is available of exercise purpose, domains, equipment, complexity and safety aspects.

Figure 1 shows the exercise library at the tablet application. Subsequent Figure 2 shows the choice of 3 levels per type of exercise. Figure 3 shows the information section of the selected exercise, including above mentioned aspects.

Table 1. Overview of the functional training exercises					
Category	Type of exercise		Level A	Level B	Level C
0. Starting positions	Starting positions		Reclining position	Seated position	Standing position
1. Standing	1. Reducing the support surface		Place feet together	Stepping feet semi tandem	Place feet in full tandem
	2. Stand on one leg		Standing on one leg	Tapping	Standing on one leg and turning the knee outwards
2. Transferring	3. Getting on and off		Stepping up and down	Get on and off with the object	Get on and off sideways
	4. Climbing stairs		Climbing stairs	Climbing stairs with a small object	Climbing stairs with shopping bag
	5. Walking		(Fast) walking	Walking on a straight line	Walk with tray
	6. Slalom		Slalom	Slalom with bucket	Slalom with tray
	7. Moving over obstacles		Raising your knees	Stepping over obstacles	Step over obstacles with object
3. Lifting objects	8. Lift and carry small objects		Lift two small objects	Lifting the pan	Walking and lifting

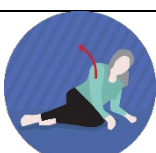
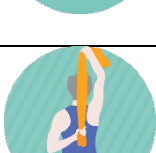
	9. Bending over and lifting from the ground		Sitting down and bending off the ground	Bending over and lifting from the ground	Bending over, lifting and walking
	10. Lift and carry large objects		Lift one shopping bag with two arms	Lift two shopping bags	Lifting and walking with groceries
	11. Reach above shoulder height		Reach above shoulder height	On the toes reach above shoulder height	Grab objects above shoulder height
	12. Reach horizontally		Reaching while seated	Reach while standing	Reaching while seated and getting up
4. Getting up	13. Getting up from a chair		Getting up from a chair with hands	Getting up from a chair without hands	Getting up from a chair with a tray
	14. Getting up from bed		Rising from bed with sideways start position	Rising from bed with supine start position	Getting up from the bed from sideways position
	15. Getting up from the ground		Getting up from the ground using the bed	Getting up from the ground using a chair	Standing up from the ground without support
5. Self-care	16. Wash and dress around the legs and feet		Tap feet seated	Seated stretching	Tap feet standing
	17. Wash and dress around the torso		Umbrella in front of the trunk from left to right	Towel in the neck from left to right	Towel behind the back from left to right

Figure 1. Screenshot functional training exercise library on tablet application.



Figure 2. Screenshot choice of 3 levels of exercise per type of exercise.

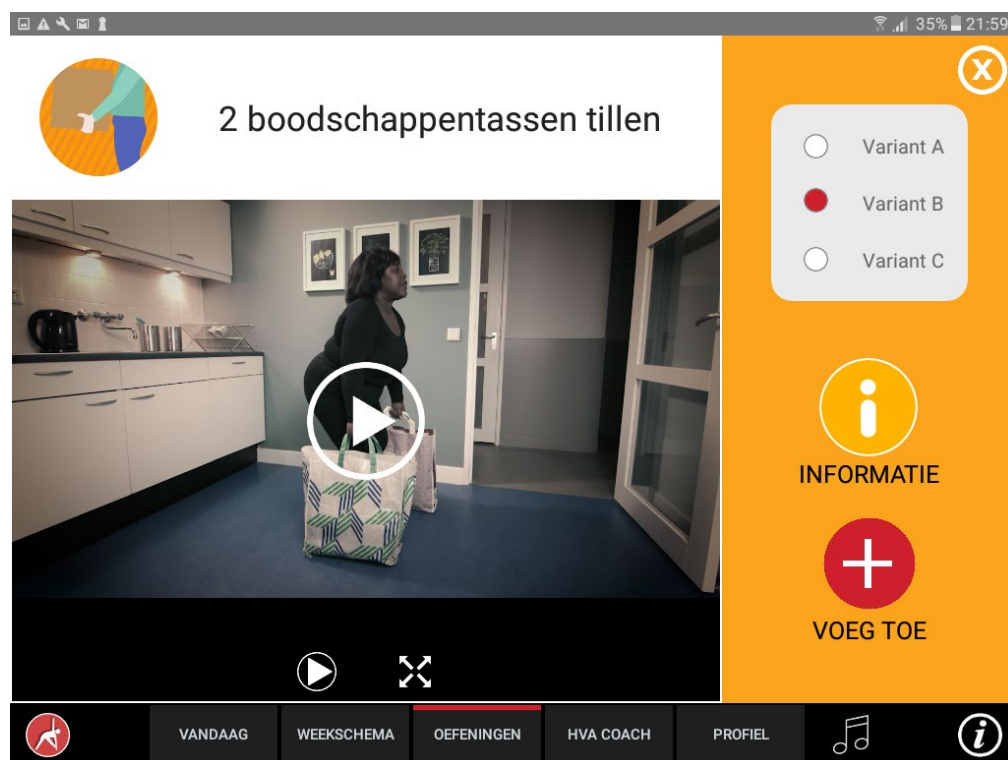
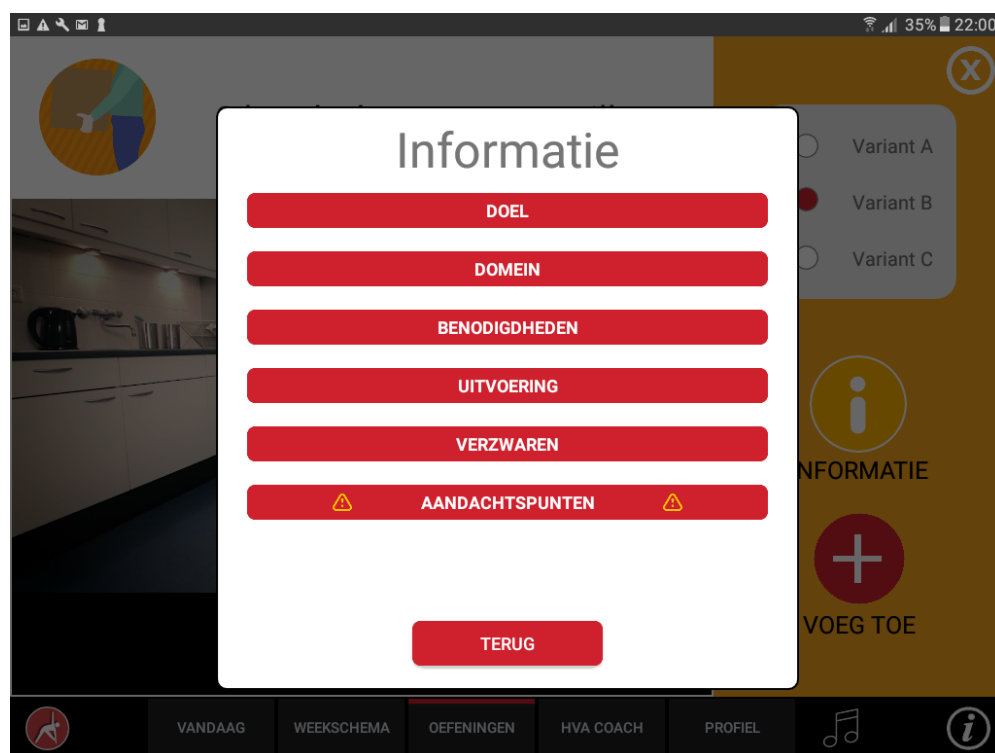


Figure 3. Exercises description is available per exercise level; purpose, domains, equipment, complexity and safety aspects.



Progressive exercise

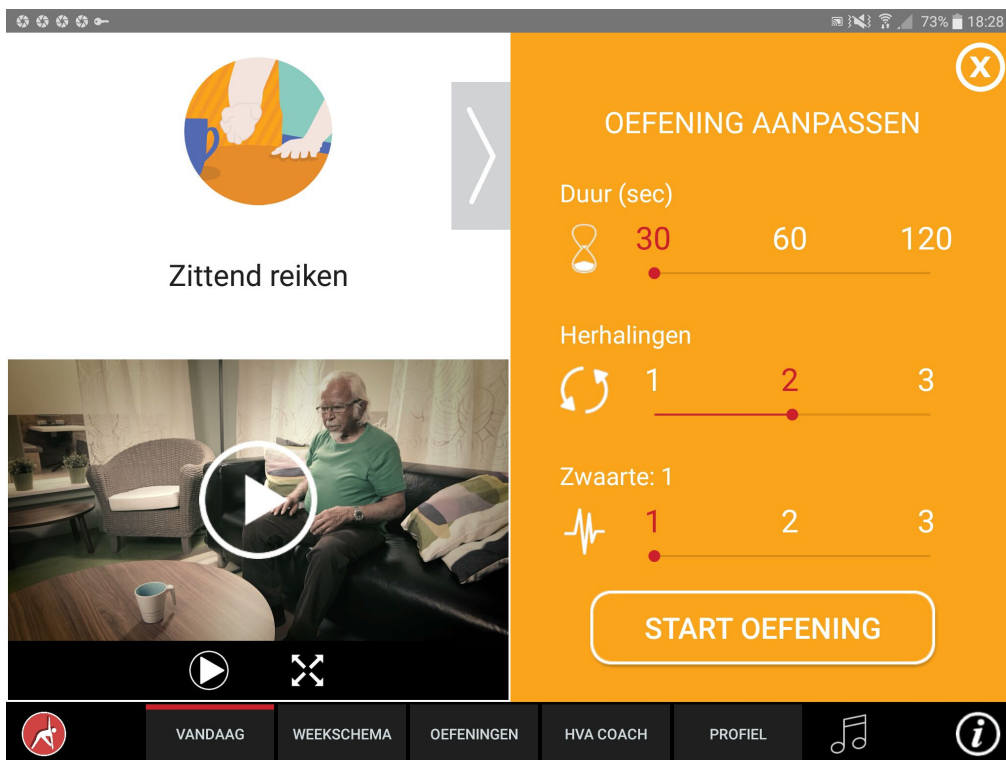
All exercises can be gradually adapted to a more progressive exercise routine, following the exercise dimensions. Whereas the first step in personalization is the choice of exercise level (A, B, C), the second step is the selection of the intensity parameters. Older adults can start with level A and the lowest parameters to get familiarization with exercise. After familiarizing themselves with these exercises they can progress with adaptations in the dimensions. First, duration can be selected at 30, 60 or 120 seconds. Second, the number of repetitive sets can be selected. And at last, the complexity is of choice. This complexity is optional by e.g. advancing motor skills, environment adaptations or by dual tasking. Complexity per level is described in the exercise library.

Moreover, in the training program every type of exercise has 3 available levels to explore (A, B, and C). See Table 2 for possible advancement in personalization and adaptations to support progressive exercise. Figure 4 shows how the personalization per type and level of exercise can be executed by the participant at the tablet application.

Tabel 2. Dimensions for progressive exercises: duration, sets and complexity per level

Level A			
Duration (sec)	30	60	120
Sets	1	2	3
Complexity	1	2	3
Level B			
Duration (sec)	30	60	120
Sets	1	2	3
Complexity	1	2	3
Level C			
Duration (sec)	30	60	120
Sets	1	2	3
Complexity	1	2	3

Figure 4. Screenshot personalization of exercise to execute exercises in progressive way.

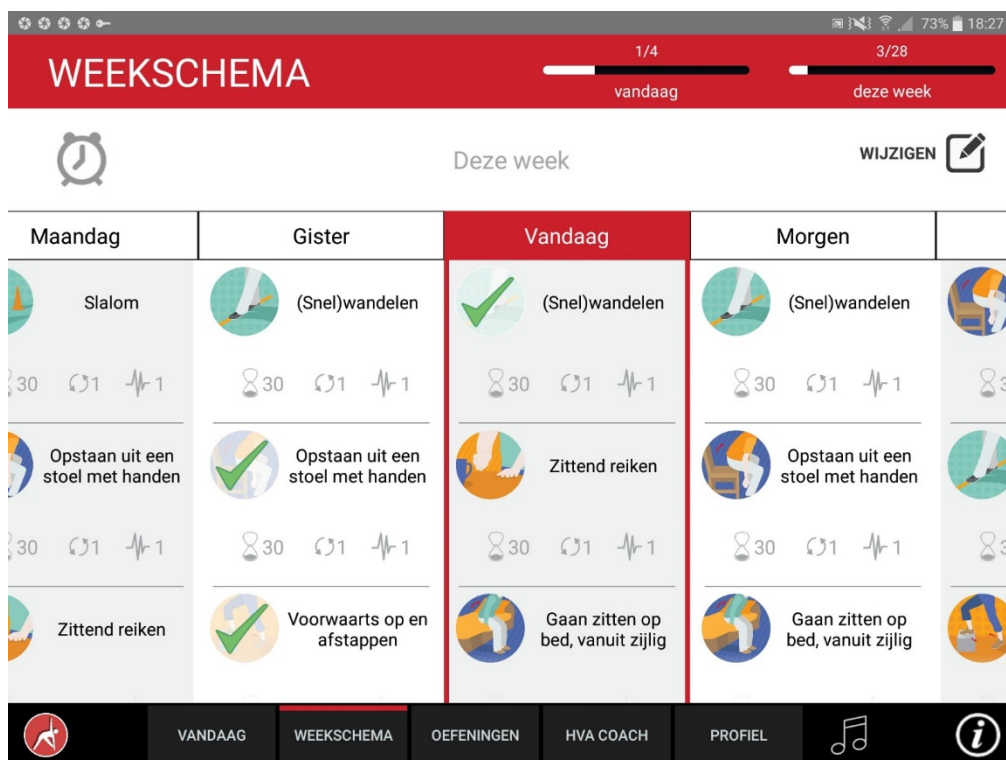


Personal goals

Both our interventions (exercise and diet) are targeting on behavior change. The personal goals (goal-setting) are an important aspect of the functional training intervention. Additional coaching supports the older adults to formulate short- and long term goals and integration of the general activity plan. The 'wizard' function in the application is supporting goal-setting and facilitates self-monitoring of this goals. Participants can generate their own personalized exercise training program by using this wizard and adapt over time. This includes selection of types, levels and choice of week days.

The combined preferred types and levels of exercise, the duration, sets and complexity result in a personalized weekly exercise schedule. Figure 5 shows an example of an exercise schedule.

Figure 5. Screenshot weekly exercise training schedule on tablet application.



Coaching and blended-approach

The functional training program is a blended intervention; an e-health application is used with additional personalized coaching. To facilitate self-regulatory behaviors specific techniques were implemented: goal setting, self-monitoring, feedback, motivational interviewing, and several other self-efficacy techniques. Because our intervention was originally designed in addition to regular weekly exercise, the cluster groups of the study were an important fundament. Important social aspects were incorporated as well, like social support from peers. (Behavior Change Techniques will be published in an upcoming scientific publication). For the coaching schedule; see also *Online supporting information Document S2*.

App design and functions

Above mentioned aspects of the functional training program are adapted in the e-health application on the tablet. As reported in our protocol paper (van den Helder et al. 2018) the application has 5 interfaces with different functions.

1. Today: today's program of personal exercises with video instructions and alterations of the exercises. After the exercise the participant ranks the exercise on intensity, difficulty and pleasantness.
2. Week planning; overview of the exercise training program for a week.
3. Exercises: an interface containing all exercises in the 18 categories of activities of daily living. Instructions and information about every exercise including safety aspects, necessary equipment and exercise purposes are present.
4. Coach: communication options to contact the coach (Skype, email or call).
5. Profile: A 'wizard' to help participants set their own program by their personal goals.

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