

 reviewed paper

How to Strengthen Non-Motorised Mobility of Elderly People? An Evidence-based Manual for the Set-up of Fall Prevention Programmes in Communities

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1 ABSTRACT

In the course of life, mobility behaviour and needs change and have to be adapted. With growing age, muscle mass reduces continuously. If this natural degradation process is not countered, the risk of falls and getting injured increases. Once a person has experienced a fall, the fear of falling again is likely to evolve. As a consequence, physical activity is associated with feelings of insecurity and is therefore avoided (post-fall-syndrome). Within the age group 55 years and older, almost a quarter of occurring falls in Austria happen in traffic (KFV, 2016). Thus, motivity and health are key prerequisites for a safe, independent and injury-free mobility. In order to tackle this topic, the Austrian Road Safety Board (KFV) developed the project “Pimp your Skills”¹ (Eichhorn et al., 2016), which focused on strengthening non-motorised mobility of elderly people and, particularly, on fall prevention. As a result, a manual on setting up an effective fall prevention programme for adults is now available.#

Keywords: balance and strength, fall prevention, non-motorised mobility, elderly, effective intervention

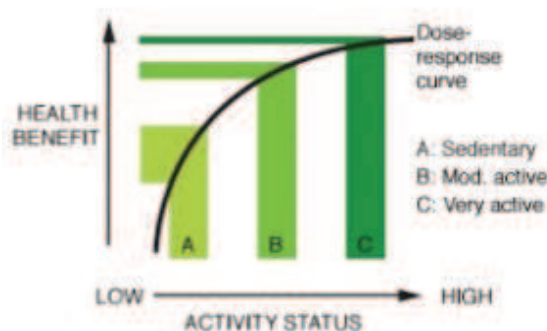
2 INTRODUCTION

In Austria, the demographic trend shows a growing, yet also ageing population. With increasing life expectancy and the baby boomer generations of the early 1960s now reaching retirement age, the number of people over the age of 65 will grow most in the future. Over 18% of the Austrian population are now in the age of retirement: a steadily growing trend that results in an ageing population. This unfolding demographic trend in Austria also has a strong impact on the mobility of older people.

As people get older, they are more and more faced with health-related and/or physical restrictions that also affect their choice of mode of transport. The available modes of transport, technological developments and personal attitudes likewise play a key role. While the car remains an important mode of transport for younger senior citizens, walking increases among the age group 75+.

However, the importance of walking in daily life is currently underestimated in mobility studies. Each individual route, no matter what primary means of transport is used, also includes a more or less longer walking distance. Consequently, walking is an essential part of everyday mobility. Experts agree that mobility and health are crucial prerequisites for being able to travel safely, independently and without injury, especially with growing age. Regular walking has a positive effect on one's own fitness² and on the other hand fitness itself is an important basis to choose walking as a mode of transport at all.

According to Pate et al. (1995) the dose-response curve represents a good estimate of the relationship between physical activity (dose) and health status/benefit (response). The lower the baseline physical activity level, the greater the health benefit associated with increased physical activities.



¹ Funded by the Austrian Road Safety Funds.

² According to the WHO (2010) older adults who are physically active exhibit higher levels of functional health, a lower risk of falling, and better cognitive function.

Fig. 1: Relationship between physical activity and health. Source: Pate et al. (1995).

Though, as accident figures in Austria show, the risk of falling increases disproportionately with growing age. In order to address the importance of active mobility with growing age adequately, the Austrian Road Safety Board (KFV) carried out the project “Pimp your Skills” (Eichhorn et al., 2016³). As it is essential to take note of both social and individual factors of influence the project considered trends in society (demographics, megatrends, future scenarios and mobility parameters) and analysed individual circumstances (lifestyles, motives, impairments and mobility behaviour). The results and insights obtained through the project with regard to independent non-motorised mobility formed the basis for a manual on setting up an effective fall prevention programme for adults. The paper presents the theoretical background and the manual itself.

3 CHANGES IN DAILY LIFE AND THEIR IMPACT ON THE RISK OF FALLING

Among other things, biological degradation processes in old age affect mobility, strength and stamina.

With reference to the sensorium, the visual perception and thus the recording and processing of visual information are reducing; e.g. especially in the case of changing or deteriorating light conditions level differences are seen less well. With increasing age in addition acoustic signals are perceived delayed or not at all.

Motor skills (stamina, strength, speed, motility and coordination) are also subject to a change in advanced years. Most notably a reduction in muscular strength and mobility is observable; e.g. a mobility loss of the cervical vertebra impedes looking to the left and right when crossing the road. Longer standing and longer walking routes as well as overcoming stairs and unevenness can also be experienced as very exhausting.

In addition, many older people suffer from disturbances of balance that can cause dizziness. It should also be noted that the use of medication can lead to side effects that affect balance as well.

These physical changes and uncertainties also affect psychological, social and emotional areas. Stress and anxiety, e.g. of crowds or falls, can lead to the fact that trips outside the home are avoided.

3.1 Balance and stability

Balance, on the one hand, is important in order to coordinate movements and, on the other hand, to react quickly and appropriately in the event of a fall. As well as muscle strength, the balance ability decreases by degrees with growing age. These processes start already at the age of 40. Furthermore, a reduced reaction time in older age leads to a greater vulnerability in case of a fall.

Several perception systems are responsible for the maintenance of the balance:

- (1) The vestibular system, which forms a part of the inner ear, perceives the position of the head and the body, and senses any body movement. This allows for controlling the reflexes in case of a fall.
- (2) The visual system (eyes, optic nerve) informs about the position of the body in the room.
- (3) The so-called sensory receptors (e.g. muscle receptors, mechanoreceptors, or free nerve endings) are located in muscles, joints, tendons, fascia and skin and control the body.

The information from these three systems is processed by the central nervous system. When it comes to balance fluctuations, it reacts to these irregularities and triggers corresponding reflexes (positional changes, muscle tension). Thus, in the case of a fall we are able to support ourselves in time with our hands. Through a balance training this "reaction process" can be improved.

In summary, balance for older ones is important for

- walking on uneven or sloping surfaces
- carrying trays, glasses/cups etc.
- an appropriate response to changes in position (interception of a fall)
- a safe and anxiety-free mobility in everyday life

³ The final report can be downloaded at: https://www.bmvit.gv.at/verkehr/strasse/sicherheit/fonds/vsf/55_pimp.html

3.2 Muscular strength

Already from an age of 30 years a continuous reduction of muscle mass occurs, if you don't do something about it. Muscle reduction in lower extremities can gradually lead to an increased risk of falling. Lest this loss affects everyday activities, muscularity should be strengthened at an early stage. Muscular strength can be trained at any age.

Exercises that strengthen the following muscle groups are recommended:

- (1) Leg muscles (e.g. quadriceps, biceps femoris, foot muscles)
- (2) Arm and shoulder muscles
- (3) Back and abdominal muscles

Especially strengthening the front of the upper thigh muscles is crucial for fall prevention. It should be remembered that strength training alone is not sufficient to avoid falls. According to Becker and Blessing-Kapelke (2011), a combination with exercises for balance is a prerequisite for a successful fall prophylaxis. According to Lacroix et al. (2014) a ratio of 2/3 balance training and 1/3 strength training has proven to be most effective.

In summary, sufficient muscle strength for the older ones is important to:

- support a straight position
- prevent muscle mass from degradation
- reduce the risk of falling
- protect the joints from pain
- be able to get up again in case of a fall and to
- enable independent mobility.

4 FALL AND FALL PREVENTION

Studies show that about a third of people over 65 years fall at least once a year (Sattin, 1992; Fall Prevention Center of Excellence, 2016). The older a person is, the more likely an injury arises from a fall.

The accident figures in Austria provide a clear picture as well: over 231,200 persons aged 55 or older annually are treated in the hospital because of a fall, of which almost a quarter occurs on traffic areas (KFV, 2016).

Age	Number of hospital-treated falls	Proportion of falls in the age group
55-64 years	50,900	5%
65-74 years	60,900	7.3%
75+ years	119,400	17.2%

Table 1: Proportion of hospital-treated falls aged 55+, Austria (extrapolation average of the years 2011-2015). Source: IDB Austria.

4.1 Main risk factors of falls

Most falls are caused by a combination of several risk factors. The more risk factors a person is exposed to, or the more pronounced a risk factor is, the greater the probability of falling.

It can be differentiated between intrinsic (personal) and extrinsic (environmental) factors causing falls (Gschwind et al., 2013; Todd et al., 2004; O'Loughlin et al., 1993).

Intrinsic factors are:

- advanced age
- previous falls
- fear of falling
- muscle weakness
- medication
- mobility and balance disorders

- visual and hearing disorders
- dizziness
- chronic diseases, e.g. incontinence, diabetes mellitus, metabolic syndrome

Extrinsic factors are:

- tripping hazards like cords and wires or carpets
- poor light conditions (unlit paths)
- unsuitable stairs (missing railings)
- slippery floor
- unsuitable shoes
- poorly adapted or misused vision aids
- poorly adapted walking aids

However, external factors play a minor role as about 90% of falls are attributed to intrinsic risk factors. In the majority of cases, diminishing or lacking muscular strength and a deterioration of balance are crucial factors.

4.2 Consequences of falls

With growing age, the severity of injuries caused by a fall increases and as a consequence, more severe physical and psychological changes are observed. Approximately 10% of falls lead to serious injuries (Eichhorn & Aigner-Breuss, 2016).

In many cases, a fall leads to a trauma that may change the usual way of life: if elderly have suffered a severe fall; e.g. fracture of femur, and had an inpatient treatment, severe consequences for their independent living are likely. Whereas three quarters of older people were still able to walk independently and without aids before a fracture this was the case for only 15% after a severe fall (LZG, 2010).

Such falls can set up a negative cycle called post-fall syndrome. Once an elderly person suffered a severe fall, the fear of falling anew is rising and self-confidence in their own physical abilities is reduced. Walking and cycling is then associated with anxiety and insecurity. Thus, all situations that appear risky or uncomfortable are avoided. If a person is untrained this leads to less activity and as a consequence to a depletion of the interaction between muscles and nerve system. This is manifested in angular, tense, and insecure movements. Subsequently, less movement leads to a further decrease of muscle strength and balance which in return results in even more uncertainties. At the end of this negative cycle stands the loss of daily living skills and social isolation.

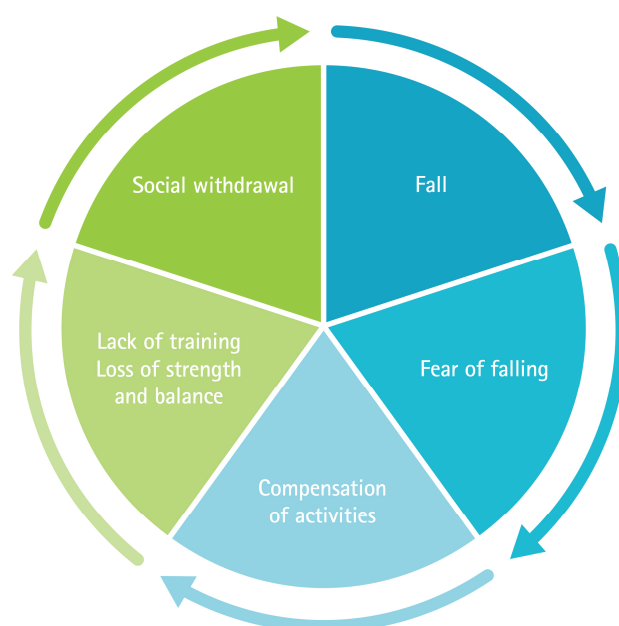


Fig. 1: Post-fall-syndrome. Source: bfu (2015). Editing: KFV

5 BE FIT – STAY MOBILE MANUAL

In most cases, the causes of a fall are a diminished or a lack of muscular strength and a deterioration of balance. However, muscularity and balance can be trained and improved at any age. This means that every person can minimize his or her risk of falling due to muscle and balance training and the maintenance of fitness.

5.1 Impacts of fall prevention programmes

Fall prevention programmes usually include a combination of strength and balance exercises, a training of one's own body awareness and an improvement of posture.

An additional benefit of a group training is gaining new social contacts, which in turn can contribute to a positive reinforcement and subsequently to more walking and cycling in daily life. An attractive and theory-based fall prevention programme thus cannot only significantly improve independence but also quality of life.

Fall prevention programmes have different approaches, with a strong variation of the achieved impacts. The following elements proved to be most effective (Sherrington et al. (2008), Todd et al., 2004; Becker et al., 2009; Lacroix et al., 2014):

- Balance exercises have the greatest impact on reducing the risk of falling. Strength exercises alone do not seem to have a positive effect. Stamina and stretching exercises alone are not suitable for fall prevention either.
- The training should be carried out at least 2 hours a week and as long as possible (at least six months), but most preferably permanently.
- Two exercise units per week show better effects than one exercise unit per week.
- The programmes can be done as a group activity as well as at home alone. However, group exercises seem to have greater training effects. Study results recommend a combination of group activity and self-activity at home.
- The programmes should be tailored to the needs of the target group to ensure that they are both challenging and safe at the same time.
- An effective programme should enhance performance by 20%.
- Before the start of a programme, a motor function test should be mandatory to assess the individual fall risk.

Among others, the Otago Exercise Programme (Campbell, J. & Robertson, C. (2003) as well as the Swiss Fall prevention training (Lacroix et al., 2014) were able to show positive effects.

5.2 Content and structure of the manual

Based on the results described above, the “be fit – stay mobile” fall prevention manual was developed by KfV experts in the field of mobility, supported by an external sport scientist (Eichhorn & Aigner-Breuss, 2016).

The manual is aimed at professional trainers and provides guidance on setting up a tailored fall prevention programme for adults, in particular for the age group 50+⁴, which can be carried out in different settings.

The manual is divided into three blocks. The first one points out the importance of activity to maintain independence in old age. The second section specifies the design of an effective training programme and the last chapter additionally gives activity tips for everyday life. Subsequently, section 2 of the manual, is described in more detail:

At the beginning of every training programme it is recommended to carry out a set of motor function tests to determine the risk of falling. At the end of the programme (ideally after 6 months), these risk assessment tests should be repeated in order to give feedback on possible improvements. All 5 tests described in the manual correspond to the quality criteria of practicability, validity and reliability.

⁴ Experts agree that fall prevention has to be initiated before the risk of falling is raising. Thus, the “be fit – stay mobile” manual suggests to start with fall prevention as early as possible, but at least at 50 years.

Selected balance and strength exercises within the manual include various levels of difficulty in order to address persons with already slightly reduced mobility as well as those who are still active. In accordance with evaluated fall prevention programmes (e.g. Lacroix, 2014) 2/3 of the “be fit – stay mobile” training exercises addresses balance and 1/3 muscular strength.

Besides physical exercises the manual suggests to include information sequences in the training units. These provide background to the exercises in particular and to the topic fall prevention in general.

Experience shows that older people are difficult to reach and to motivate for preventive measures. Therefore, the manual further provides suggestions on how to address different target groups and gives examples on how to implement a fall prevention programme in varied settings. Within the project “Pimp your Skills” four different types of active mobility could be derived in that respect.

- People of the “adventurous” type are very mobile and a lot of them are still working. They can be characterised as open-minded, flexible and easily to be enthused by new ideas or options (particularly, there is a keen interest in technological innovations). They don’t exercise for the sake of their health, they do so for fun. Health in itself is not an important issue for this group.
- People of the “responsible” type are very mobile as well. They can be described as conscientious and ecologically sensitive. This is expressed in a conscientious lifestyle. Health is more important to this group than fitness, which is also reflected in a very high proportion of every day cyclists.
- People of the “wait-and-see” type are partially retired. Physical activities are especially done when external stimuli are offered, e.g. get-togethers with friends or family. They often play an important role in the family and take on care tasks. This group could be motivated by health and environmental issues.
- People of the “comfortable” type are mainly retired. They can be characterised above all as comfortable and safety-driven, e.g. cycling is experienced as rather unsafe. Health and fitness issues do not have any priority, and this group shows only limited willingness to try something new. If at all, they could be addressed with environmental issues.

Additional information on these types of mobility (training contents, examples for different settings and a listing of possible and appropriate strategic partners) in the manual enables the trainer to motivate different participants in a respective way.

Printed versions of the manual are distributed on congresses or in interested communities. The online version (German language with English abstract) is available at the KFV website.⁵

6 CONCLUSION

Walking is a fundamental part of daily mobility in growing age. However, the age group 65+ shows an increased risk of falling and changes of physical conditions due to ageing. This has consequences on mobility behaviour. Nonetheless, effective fall prevention programmes prove that these changes are reversible to a considerable extent. Therefore, fall prevention programmes are effective to maintain independent mobility as long as possible. The manual “be fit – stay mobile” addresses persons with a professional background in the field of physical activity or therapy. Furthermore, it is aimed at multipliers who want to develop and promote exercise programmes in municipalities or institutions.

In a next step, a fall prevention pilot training on the basic suggestions of the manual will be developed including an evaluation of the effectiveness comparing a test and control group. Additional to physical changes raising knowledge on the correct performance of strength and balance exercises as well as enhancing self-efficacy should be initiated.

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⁵ https://www.kfv.at/fileadmin/user_upload/Handbuch_Skills.pdf

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