Chapter 8

General Discussion
Introduction

The main issue addressed in this thesis is the apparent withdrawal of older persons from physical activities that they perceive as too dangerous (too demanding) relative to their capability to control their balance. By doing so, they may reduce their falls risk. Thus individuals may mask their difficulty in controlling their balance by reducing their exposure to hazards (i.e., by reducing physical activity). The relevance of exposure to hazards as a factor associated with falls risk is generally acknowledged, but until now it has not been addressed systematically in research. The aim of the studies described in this thesis was to investigate, within the framework of research into falls risk among older persons, the significance of the level of physical activity as a measure of exposure.

Summary and main findings

Several prospective follow-up studies and secondary data analyses were conducted from 1994 until 2008, to investigate the relevance of physical activity as a measure of exposure. The follow-up studies required a reliable method for establishing whether participants had fallen and the circumstances and consequences of these falls. A major drawback of existing methods was that they were time-consuming to manage and required respondents to take the initiative to report falls. We therefore developed an innovative method to register falls among older persons, using interactive voice response technology: the Telephone Inquiry System (TIS). Respondents were telephoned monthly by a computer and could respond to questions by answering ‘yes’ or ‘no’.

We found that the TIS is feasible in terms of the willingness and ability of older persons to use the system. We also demonstrated that the system is reliable for registering accidents and falls among community-dwelling elderly individuals, as described in chapter 2. The availability of the TIS was an important condition for conducting prospective follow-up studies, not only for the registration of falls but also for obtaining information about the circumstances and consequences of the falls (i.e., location, time, and injury of the fall) from a large number of respondents. The circumstances under which falls occurred appeared to be important for the interpretation of the processes that might be involved in the causation of falls. In 1999, we used the TIS in the ‘Safety in your own hands study’, as described in chapter 3. In this study, we evaluated the effect of a multifactor community intervention to reduce all falls (at home and outside the home) among older persons in Sneek in comparison to two control communities (Harlingen and Heerenveen).
Although the number of falls was not reduced, we measured a selective relative reduction in falls outside the home among women. We also found that a low level of participation in outdoor physical activity was associated with this reduction in outdoor falls. Also, a low level of outdoor physical activity appeared to be associated with an increased number of indoor falls, probably because subjects with a low level of outdoor physical activity spent more time at home.

Based on the results of this study, we assumed that the level of indoor and outdoor physical activity is associated with the number of indoor and outdoor falls. Because there were no relevant data in the literature, we performed two studies to investigate this relationship. The first study addressed indoor falls and the second study outdoor falls, each associated with related levels of physical activity.

The first study addressed the association between the 24-hour distribution of the level of physical activity in the home and indoor falls, as described in chapter 4. We found that physical activity was strongly associated with the number of falls in the home, measured over 24 hours. In addition, we found that especially at night the number of falls per 1000 active person-hours was relatively high compared with the number of falls during the day. This indicated that older persons might be at increased risk of falling if they are encouraged, for instance by physical activity promotion interventions, to become more physically active. Also, if older persons frequently get out of bed at night, they are frequently exposed to specific night time hazards (i.e.: reduced vision) which increases their risk of falling. Thus in addition to the health-related factors reported in the literature, changes in the level of physical activity should also be taken into account when estimating a person's risk of falling.

The second study addressed the relationship between the level of outdoor physical activity (walking and bicycling) and outdoor falls during walking and bicycling, as described in chapter 5. The aim of this study was to test the assumption that the level of outdoor physical activity mediates the relationship between fear of falling and actual outdoor falls. The results showed that people with a high fear of falling were more often ‘low to moderately active’ or ‘active’ compared with people who had no such fears, who were more often ‘very active’. While fear of falling was not associated with outdoor falls, it was after the level of outdoor physical activity was taken into account. Older persons with high fear of falling fell more often per unit of physical activity (frequency of outdoor walking or bicycling). We concluded that outdoor physical activity mediated the relationship between fear of falling and actual outdoor falls.

In two letters, Lacharez et al. and Hafeman et al. expressed the need for theoretical considerations about the causal relationship between fragility, fear of falling, physical activity, and falls. Because no such causal model was available in the literature, we
developed a hypothetical causal model of falls, as described in chapter 5. On the basis of this model, the term ‘inconsistent mediation’ might be more appropriate to describe the causal relationships between fear of falling, falls, and physical activity. In this model, the level of physical activity is considered as a measure of exposure to hazards which affect balance control.

In chapter 6, we formulated a more elaborate conceptual model of falls from the perspective of individual behaviour in controlling balance: the Balance control Difficulty Homeostasis model of falls (BDH model). A central element of the model is that older persons perceive their own balance control capability and the demands made on it. Older people might experience that they can control their balance quite adequately by changing the level of physical activity. Their falls risk increases as they might tend to accept a smaller safety margin between their capability to control balance and the demands made on them to control their balance. In addition, they might become less accurate in estimating the difficulty of maintaining their balance, for instance because of increased variability of their capability to control their balance.

This newly proposed model is derived from the TCI model of Fuller, which describes the behaviour of drivers. The BDH model describes several mechanisms that contribute to explaining why older people generally do not feel the need to take specific preventive measures against falls.

In chapter 7, we introduced the level of physical activity as nominator in an expression of the Falls Risk by Exposure, the so-called FARE. In this study, falls risk was expressed as the number of fallers per 1000 person-years, a commonly used expression for falls risk, and as the number of fallers per 1000 physically active person-days. Increased difficulty in controlling balance was associated with an increased falls risk per 1000 person-years in a linear fashion, whereas it increased in an exponential manner with the FARE method. Because the FARE method takes into account the risk compensation behaviour of older persons who experience increased difficulty controlling their balance, it is recommended for use in public health policy and research on falls prevention.
In summary, the main observations from the studies described in this thesis are:

1. Older persons perceive their capability to control their balance and the demands that are made on this capability.\textsuperscript{4,11}

2. If older persons perceive an increased difficulty in controlling their balance or express fear of falling, they tend to avoid hazards and thereby reduce their physical activity.\textsuperscript{12}

3. There are large differences in the level of physical activity among older persons who experience different levels of difficulty in controlling balance (Chapter 7).

4. The level of indoor and outdoor physical activity is related to indoor and outdoor falls, respectively; reducing physical activity reduces the falls incidence per 1000 person-years (Chapters 4, 5).\textsuperscript{a,b}

5. Older persons who reduce their physical activity due to perceived difficulties in controlling balance also reduce their exposure to hazards and thereby prevent themselves from falling in the short term (Chapters 4, 5).\textsuperscript{a,b}

6. The FARE (the number of fallers per 1000 physically active person-days) increases exponentially in older persons with increasing difficulty in controlling balance compared with the slight and linear increase when falls risk is expressed as the number of fallers per 1000 person-years (Chapter 7).

**General conclusion**

The following general conclusion can be drawn from the results of the studies described above. Older persons perceive their capability of controlling balance and the demands made on this capability. A general strategy used by older persons to control balance is to reduce physical activity. This appears to be an effective strategy in the short term because it reduces exposure to hazards, thereby limiting the likelihood that a person will fall. Consequently, the level of physical activity as a measure of exposure to hazards is an essential factor that should be included in estimation of the falls risk of older persons.

**Methodological considerations**

Some aspects of the validity and reliability of the findings related to the importance of the level of physical activity as a measure of exposure to hazards will be addressed.
Validity of the findings

The validity of the findings is supported by the fact that they are based on different studies, and that comparable outcomes were found for indoor and outdoor falls. The level of physical activity appeared to be related to involvement in falls. Reduced levels of physical activity reduced involvement in falls.

In addition, it is of interest to investigate whether the suggested behavioural adaptation of older persons to perceived hazards is also found in other domains, such as participation in traffic. The tendency to withdraw from hazards has been studied extensively among older drivers. In his thesis ‘Self regulation of the driving behaviour of older drivers’, Baldock reviewed the literature on the involvement of older and younger drivers in crashes. While older drivers (aged over 65) had fewer crashes than younger drivers, they had a higher crash rate per kilometre driven.

The analysis of older driver involvement in traffic accidents addressed a number of driving characteristics. Older drivers travel fewer kilometres per year than younger drivers and tend to avoid: driving at night, in inclement weather or busy traffic (high traffic roads, peak hour traffic times), on high-speed roads, in unfamiliar areas or roads, making unprotected turns across traffic or at complex junctions. Thus older drivers are less likely to be involved in a crash occurring during difficult driving conditions, such as during peak hour traffic, darkness, or wet weather than their younger counterparts. This finding is generally thought to reflect the tendency of older drivers to reduce exposure to crash involvement in these difficult driving conditions. It does not indicate that older drivers are better than younger drivers in maintaining control of the driving task during these difficult circumstances. Thus it would seem that older persons tend to withdraw from difficult and demanding situations not only with regard to maintaining their balance control, but also with regard to driving. This finding supports the validity of our findings.

Reliability of the findings

A factor related to the reliability of the findings is the way the level of physical activity is measured. In our studies we used different measures (outdoor walking and cycling, indoor physical activity per 2-hours interval during a day, number of physical active person-days). The application of these various physical activity measures resulted in coherent findings as we considered their association with falls. However, the absence of consensus about a valid and reliable measure of physical activity limits the reliability of the findings concerning the level of physical activity of persons. This means that we were not able to measure the level of physical activity according to a golden standard, but we could adequately rank persons according to their relative level of physical activity.

General Discussion
Implications of the findings

Before discussing some general implications of the findings, we present a scheme for the process of withdrawal from hazards to control balance (figure 1). The figure illustrates, at the individual level, some age-related general processes that are of relevance for falls prevention. These processes are described in chapter 6, in which the Balance control Difficulty Homeostasis model is presented. Figure 1 illustrates the following age-related processes:

- The level of balance control capability decreases, and its variability increases,
- The level of demand on balance control decreases, and consequently its variability decreases because the range of demands becomes narrower,
- The safety margin between the level of balance control capability and the level of balance control demand diminishes,
- Three age-related phases of balance control capability and demand can be distinguished, as described below.

**Figure 1**  Schematic representation of hypothesized level of balance control capability of a person and its variability (area), the level of balance control demand and its variability (area), and the difference between them (the safety margin) for three age phases.

1 The level of balance control demand (>0) that a person is most frequently exposed to during a certain time interval (e.g., 24 hours): the mode level. A person will also be exposed less frequently to demands at levels higher (or lower) than the mode level. Depending on the level of demand and the concurrent level of balance control capability, a person will (or will not) lose control of balance and fall.
**Phase 1**
In the first phase, the capability to control balance is high and its variability is low.
This means that the balance control system functions at a high level and is highly reliable. This implies that a person can afford to perform physical activities that make low to high demands on the ability to control balance; the variability of demands is high. Performing demanding physical activities successfully increases the capability to control balance because of an exercise effect. The safety margin between the levels of balance control demand and balance control capability is wide, so that there is generally little difficulty controlling balance. Consequently, the probability of falling per 1000 person-years is relatively low. Moreover, the long-term impact of a fall is relatively mild due to the high ability to recover from injury at a younger age.\(^{28-30}\)

**Phase 2**
In the second phase, the capability to control balance gradually diminishes as a result of ageing, medication use, chronic disease or lack of physical activity.\(^{31,32}\) In addition, the hour-to-hour or day-to-day variability in this capability increases because, for example, of an earlier onset of tiredness,\(^{20}\) the impact of increased use of medication, or postural hypotension. As persons perceive a decrease in their capability to control balance, they tend to compensate for this by avoiding the most demanding physical activities.\(^{33}\) However, conflicting motives, values, and strong habits inhibit full compensation for the decreased capability to control balance, for instance because persons are expected (and also willing to meet these expectations) to continue to do their daily shopping although it becomes increasingly difficult for them. The compensation process results in a gradual reduction in the variability in balance control demands, because the most demanding physical activities are avoided. Consequently, the safety margin between the capability to control balance and demands made on this capability is reduced. The frequency of performing physical activities associated with an increased difficulty to control balance increases gradually with age, as persons develop difficulties with everyday physical activities like walking or getting out of a chair. As a result, the probability of falling per 1000 person-years increases. Moreover, the long-term impact of a fall becomes more serious due to increasing frailty with ageing, which reduces the ability to recover from injury.\(^{28-30}\)

**Phase 3**
In the third phase, the capability to control balance is low and its hour-to-hour or day-to-day variability has become very high. Habitual behavioural patterns, and conflicting motives and values strongly inhibit further compensation for the low capability to control balance because many potentially hazardous physical activities...
are required for independent living. Consequently, the safety margin between balance control capability and demand is strongly reduced. The frequency of performing physical activities associated with great difficulty in controlling balance is much higher (e.g.: serious difficulty in controlling balance when getting out of bed or chair or walking outside the home for shopping). In combination with the relatively high variability in the capability to control balance, such as might occur due to medication use or postural hypotension, the probability of falling per 1000 person-years is strongly increased. In general, the injuries due to a fall are more serious because of increased frailty (e.g.: increased incidence of fractures), and also because a person's ability to recover is strongly reduced.\(^{28-30}\)

These general tendencies, as shown in figure 1, illustrate the process at the individual level. However, the process has some important implications for research on risk factors for falls and evaluation of falls prevention interventions at the population level. These implications are addressed below and relate to:
- The identification of risk factors and persons at risk for falls,
- The willingness of older persons to participate in falls prevention interventions,
- The evaluation of falls prevention interventions,
- Public health policy on falls prevention.

• **The identification of risk factors or persons at risk for falls**

As illustrated in phase 2 of figure 1, older persons actually manage to control their balance well, even though their capabilities to do so are substantially reduced.\(^{4,34}\) Their generally successful behavioural adaptation (reduction of physical activity) to their reduced capability to control balance implies that this capability is strongly reduced as persons start to lose balance control and fall frequently (phase 3). Characteristics of frequent fallers support this assumed process. Frequent fallers per 1000 person-years\(^{35-36}\) are generally found among persons aged 75 or older\(^{30}\). In this age group, often multiple risk factors for falling are identified, including a strongly decreased capability to control balance, and these persons appear to be physically inactive.\(^{30}\) These studies did however not identify that older persons mask their reduced balance control capability successfully by behavioural adaptation (reducing their level of physical activity).\(^{4,37}\)

Based on the process as illustrated in figure 1, it is expected that the capability to control balance is already deteriorating before persons start to fall frequently.\(^{34}\)

**Conclusion**

Research on risk factors for falls and identifying persons at risk for falling needs to address the decreasing capability to control balance, as illustrated in figure 1, phase 2. In order to establish when this decreasing capability to control balance reaches
a critical level, the estimation of the fall risk should include the level of physical activity as a measure of exposure. For this reason, the FARE, the number of falls or fallers per 1000 physical active days (as described in chapter 7), is recommended as an outcome measure for studies of risk factors and identification of persons at risk of falling.

- **The willingness of older persons to participate in falls prevention interventions**

In general, the willingness of older persons to participate in falls prevention programmes is limited, even among those who have fallen recently. Figure 1 suggests that ageing persons are quite successful in controlling their balance by behavioural adaptation during a period in which their capability to control balance is diminishing (phase 2). This might imply that older persons think that they can control or influence their capability to maintain balance. This pattern of coping with reduced balance control is also observed among persons with fear of falling, who generally tend to reduce their level of physical activity. Thus while older persons consider falls prevention as an important issue, in general (especially as they express their fear) they consider the risk of falling to be highly controllable by behavioural adaptation. Many individuals are quite successful in preventing falls, and most do not fall even once a year while performing many activities that require some minimum level of balance control. From research on risk perception and behaviour in other areas, it is known that the perception of being in control is a key predictor of the decision to perform, or to continue to perform, activities that might be relatively harmful.

This relatively successful strategy to control balance might partly explain why older persons reject the idea of participating in falls prevention interventions. Being careful and avoiding danger are the preferred falls prevention strategies; however, in the long term use of these strategies means that while a person’s capability of controlling balance is very low, there is little room to reduce physical activity further without compromising independence.

**Conclusion**

The fact that older persons are generally quite successful in controlling their balance contributes to their reluctance to participate in falls prevention programmes. Most persons at risk of falling might feel that they control their balance quite adequately. This seriously questions the public health impact of the approach of asking persons at risk to participate in falls prevention programmes.
• **The evaluation of falls prevention interventions**

The central issue with regard to the evaluation of falls prevention interventions is the homeostatic nature of the behavioural adaptation persons make in response to their perceived capability to control balance. When evaluating the effect of falls prevention interventions, it is important to appreciate that if the capability to control balance is improved, older persons tend to increase the demands made on this capability, by becoming more physically active, as described in the BDH model in chapter 6. Consequently, the incidence of falls will probably not be reduced because of the increased exposure to hazards. Potentially successful interventions might be classified as ineffective (no falls reduction) even though they improved the capability to control balance. On the other hand, if one of the effects of a falls prevention intervention is that older persons became more physically inactive, a reduction in falls may be observed which might be the consequence of reduced exposure to hazards (reduced physical activity).

**Conclusion**

In order to evaluate falls prevention interventions properly, the change in the level of physical activity among participants and controls should be measured. In general, published evaluation studies do not take changes in physical activity into account, which raises doubts about the validity of the conclusions drawn from these studies. Therefore, the newly developed FARE, the number of falls or fallers per 1000 physical active person-days (as described in chapter 7), is recommended as a more appropriate outcome measure for evaluation studies.

• **Public health policy on falls prevention**

The deterioration in the capability to control balance, as shown in figure 1, phase 2, can be regarded as an example of a classical pattern observed in other fields of research on accident prevention, namely, ‘drift into failure’. ‘Drift into failure’ is described as a slow, incremental movement of systems operations (for balance control) towards the edge of their safety envelope. ‘Drift into failure’ is hard to recognize because it is about normal people doing normal work (behaving normally), and not about obvious breakdowns or failures. What is perceived as ‘normal’ may be based on what is frequently perceived among older persons: many have difficulty with walking, climbing stairs, or getting up from a chair. These difficulties are frequently observed by older persons themselves (among peers), and also by ‘others’, such as family members, and professionals (welfare workers, general practitioners, medical specialists, designers, politicians). Among older persons and the ‘others’, the perception of ‘normality’ and ‘acceptability’ of the balance control difficulties of older persons may be influenced by the idea that they are quite adequately coping
with these difficulties, because they do not fall often. These ‘others’ are referred to as the ‘system’ that surrounds the individual older person with implicit and explicit opinions, expectations, policies, and demands affecting balance control. From statistics on falls-related injuries, it is becoming increasingly clear that the difficulties in controlling balance experienced by many older persons cause them to ‘drift into failure’, as reflected by the observation that about a third of older persons (65+) fall at least once a year.21,30

When addressing the issue of falls prevention policy, a distinction should be made between the older individual who is at risk of falling and the system surrounding the individual. This distinction fits into the two accident prevention approaches described by Reason,50 namely, the person approach and the system approach, which will be illustrated below.

The person approach
Reason50 describes the person approach as a widespread and longstanding strategy that is primarily based on the study of risk profiles and the unsafe behaviour of persons who are involved in accidents (falls). The associated countermeasures are mainly directed at reducing unwanted variability in behaviour (restoring balance control) among those who are at risk (older persons at risk of falling). In this approach, persons are viewed as free agents capable of choosing between safe and unsafe modes of behaviour, and therefore the focus is directed towards the persons at risk. A serious weakness of the person approach is that by focussing on the individual origins of accidents (falls), it isolates unsafe acts from their system context. In falls prevention, this approach is seen in attempts to involve older persons in, for example, physical exercise programmes. One of the aims of these programmes is to change an older person’s ‘normal’ pattern of withdrawing from difficult physical activities to a more challenging style of coping with their generally low capability to control balance. Several randomized controlled trials (RCTs) have concluded that this approach can reduce falls,2,51 but some important difficulties still remain that limit the impact of these programmes on the public health problem. These difficulties are:

1. It appears difficult to replicate the results of the RCT intervention programme in an applied setting.52,53
2. The willingness of persons at risk to participate in a falls prevention intervention programme is generally low.38-42
3. Interventions are tailored to those with a high falls risk. This approach does not address the source of the problem, the process of a decreasing capability to control balance among many older persons, a process that starts long before individuals are actually at risk of falling.4,34
The system approach
According to the system approach,\textsuperscript{50} accidents (falls) are seen as consequences having their origins in ‘upstream’ systemic factors. These upstream systemic factors are factors that might help accidents to happen. For instance, the probability of accidents increases if social pressure or pressure from managers/colleagues forces persons to perform continuously difficult tasks with lack of appropriate devices. These demanding circumstances may be created by decision makers or politicians due to lack of understanding of the full range of (long term) consequences of their policies. These factors might put persons in a situation which provokes mistakes and leading to serious consequences. For instance, if stairs are poorly maintained and handrails are not fixed properly, a slip may result in a breakdown of the handrails (defence) and a serious fall.

The assumption of the systemic approach is that though the human condition cannot adequately be changed, the conditions under which persons are functioning can. In order to change these conditions (building upstream defences), knowledge is required about those processes that have consequences for safety. Actually, building and maintaining these defences should prevent the classical pattern of ‘drifting into failure’.\textsuperscript{49}

From the perspective of the system approach, the results described in this thesis provide insights into how to develop an upstream defence in relation to falls prevention. A process that contributes to the ‘drifting into failure’ (falling) of older persons is the pattern of behavioural compensation, which is illustrated in figure 1. This pattern undermines the capability to control balance until compensation is no longer possible due to the high complexity of the balance problems. The suggested defence is to set a standard for the required minimal capability for controlling balance for a given activity.\textsuperscript{54} Prevention of falls should focus on measuring and maintaining this required level of capability. In order to establish this defence, healthcare professionals should have access to adequate instruments to measure the capability to control balance and should be informed about possible interventions to maintain and restore this capability. For development and implementation of required instruments, standards and procedures, a political and social commitment to improve the quality (i.e.: balance control) and quantity of physical activity is an important condition. There are some indications which illustrate the current commitment on falls and improving physical activity among older persons. At the European and Dutch political level, falls among older persons is increasingly recognised as an important domain for prevention.\textsuperscript{55} The current Dutch policy regarding ‘Exercise on receipt’ in the healthcare setting\textsuperscript{56} is a possible framework for implementing defences against the diminished balance control of older persons. Another approach that may directly or indirectly contribute to falls prevention is the policy to stimulate physical activity
among older persons (50+), a campaign from the NISB (NISB www. 30 minuten).

This national campaign also stimulates the discussion about the issue of how to increase the level of physical activity among older persons in general, and how to do that safely for older persons with certain chronic diseases or reduced balance control capability.

**Conclusion**

The person approach to falls prevention has shown its effectiveness in small-scale studies, but its impact at a public health level is still limited. The issue of falls prevention should be primarily oriented to professionals who are involved in the healthcare and welfare of older persons. These professionals should screen for, and if necessary treat, those factors related to emerging balance problems before older people start to reduce their physical activity and in the end lose control of their balance. In addition, environmental modifications made by designers and decisions made by politicians (i.e.: criteria for home-care, funding of research and development) which will affect balance control difficulty among older persons should be systematically identified and alternatives should be offered from the perspective of falls prevention.

**Future research**

The results of the studies described here have implications for future research.

*The identification of risk factors and persons at risk for falls*

Research on risk factors for falls should include a measure of exposure in the outcome measure. The FARE is recommended as measure of FAlls Risk by Exposure. Measures of exposure to specific hazards need to be developed further for different populations and environments. For instance, a distinction could be made between the level of participation in indoor and outdoor activities. The development of exposure measures requires the further development and validation of measures of physical activity among older persons.

As was indicated in figure 1, a factor that is assumed to increase the risk of falling is the increased variability in capability to control balance control among persons, which might reduce the estimation of their actual capability to control balance. This variability is generally not taken into account in falls risk research and therefore needs attention.
The willingness of older persons to participate in falls prevention interventions

Research should focus on factors that contribute to involvement of older persons in programmes that enhance balance control capability.

The evaluation of falls prevention interventions

In the evaluation of falls prevention interventions, changes in physical activity need to be addressed in order to control for homeostatic behavioural adaptation due to perceived changes in difficulty in controlling balance among participants. This requires that the level of physical activity be monitored before and after the interventions.

Public health policy on falls prevention

In addition to the evidence-based benefits of the person approach to falls prevention, more research is required to identify elements in the system surrounding older persons that counteract a reduction in falls and injuries. Examples of these system elements are: social norms or opinions about how to deal with balance control difficulties; should one treat balance control problems, or should one reduce physical activity to cope with it. But also professionals in healthcare, architecture or environmental design may contribute to increased falls, for instance: by prescribing medication which reduces balance control, or designing environments which are too demanding for older persons. Finally, important system elements are politicians at the local and national level who will decide on issues which probably do not directly have an impact on falls risk, but whose decisions will contribute to a decrease in the balance control safety margin. Possible relevant policy issues are: public transportation, housing, criteria for home-care, and funding of development of instruments for early detection and treatment of reduced balance control capabilities.

Within each system element, factors should be identified that influence the ratio between capability to control balance and the demands made on this capability. Knowledge about processes and trends in these factors might provide the opportunity for developing ‘upstream’ defences against loss of balance control. As a frame of reference for advocating the need of developing upstream defences, a standard for the minimum required safety margin between balance control capability and balance control demands needs to be established. The development and implementation of such a standard requires innovative research which will contribute to a system which increasingly provides sustainable balance control among older persons for the benefit of public health.
Literature

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