Chapter 5

Fragility, fear of falling, physical activity and falls among older persons: Some theoretical considerations to interpret mediation

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Abstract

Background
In their letters to the editor, Lacharez et al. and Hafeman & Schwartz questioned the correctness of using the term 'mediation' in our paper. In this paper, we concluded that (outdoor) physical activity mediates the relationship between fear of falling and outdoor falls. We investigated whether the term ‘inconsistent mediation' might be a more appropriate term to use in this context.

Methods
Based on literature, we describe the relationship between fear of falling, physical activity, and falls within a causal model.

Results
Two causal pathways between fear and falls exist, with the causal pathway going from fear of falling via physical activity to falls counteracting (is inconsistent with) the causal pathway going from Fear of falling via hesitancy to falls.

Conclusion
The term ‘inconsistent mediation’ might be more appropriate to describe the causal relationships between fear of falling, falls, and physical activity.
Introduction

In their letters to the editor, Lacharez et al.\(^1\) and Hafeman & Schwartz\(^2\) questioned the correctness of using the term ‘mediation’ in our paper\(^3\). In this paper, we concluded that (outdoor) physical activity mediates the relationship between fear of falling and outdoor falls. Both letters suggested that it would be more appropriate to use the term ‘suppression’, and expressed the need for a theoretical basis for the terminology used to describe this relationship. Lacharez et al.\(^1\) specifically mentioned the lack of evidence for assuming a causal relationship between fear of falling and falls.

The purpose of this letter is to describe the relationship between fear of falling, physical activity, and falls within a causal model, and investigate whether the term ‘inconsistent mediation’ might be a more appropriate term to use in this context.

Theoretical considerations: a hypothesized causal model of falls

People fall when it becomes too difficult for them to control their balance, that is, when the demands on balance control (e.g.: exposure to indoor and outdoor environmental influences) at a certain point in time become greater than their capabilities (body function) to control balance.\(^3\) For the current purpose only the following three factors which theoretically independently increase the risk of falling (figure 1) are included in the causal model. Other factors related to falls are not addressed because they are not regarded as relevant for the purpose of this letter.

The first factor is fragility (also referred to as frailty\(^4\)). All other factors being equal, increased fragility increases the risk of falls because the decline in body functions that underlies fragility leads to a diminished capability to control balance. Evidence for this relationship comes from Pluijm et al.\(^5\) and Delbaere et al.\(^6\)

The second factor is hesitancy due to fear of falling. People who are afraid of falling frequently shift their control of balance from a fast to a slow mode of control.\(^7,8\)

In the fast mode, balance control takes place automatically, without noticeable conscious involvement. In this mode, information from the periphery activates the most adequate coordinative structures.\(^7\) In the slow mode, balance control is largely cognitive and the execution of movements takes place with substantial conscious involvement and is often dependent on visual information.\(^7,8\) In this slow (hesitancy) mode of control, less adequate coordinative structures are involved, which implies that balance control might be reduced.\(^7\) Evidence for this mechanism is found in studies showing an increased fear of falling to be independently associated with reduced balance control\(^9,10\) and fear of falling to be a predictor of falls independent of factors related to physical frailty.\(^5,6\) Therefore, we conclude that there is evidence to
support that fear of falling, leading to hesitancy, reduces balance control capability and is causally related to an increased risk of falling. The third is factor is physical activity, which increases balance control demands by increasing exposure to various environmental influences. In our study, we found that increased outdoor physical activity was associated with increased risk of outdoor falls.

Figure 1 Independent causal relationship of falls with hesitancy, fragility, hesitancy (due to fear) and physical activity.

Our causal model which is presented in figure 2 links fragility, fear of falling, physical activity, hesitancy, and falls, and is based on the two schematic models suggested earlier by Hafeman & Schwartz. The signs between variables in figure 2 do not represent statistical associations, but theoretical causal relationships. The proposed causal mechanism starts with increasing fragility as individuals become older. Apart from increasing the risk of falls, fragility also leads to a fear of falling as individuals become aware of their difficulty controlling their balance. Evidence for this relationship comes from a study by Friedman et al., who showed that women with a history of stroke were at risk of falls and also at risk of developing fear of falling at follow-up. In addition, fragility is often found to be associated with fear of falling. In turn, fear of falling causes hesitancy, which also increases the risk of falling. However, once older individuals perceive that they have more difficulty controlling their balance and become afraid of falling, they tend to reduce or avoid this difficulty by, for instance, withdrawing from demanding situations (e.g., uneven pavements, walking stairs) in order to remain in control of balance. Therefore it is suggested that fear of falling causes a reduction in physical activity (negative sign in figure 2). Subsequently, the reduction of physical activity causes a reduction of...
falls (negative sign in figure 2), because reduction of physical activity is a protective strategy against falling, at least in the short term.  

![Hypothesized causal model linking fragility, fear of falling, physical activity, hesitancy, and falls.](image)

**Figure 2** Hypothesized causal model linking fragility, fear of falling, physical activity, hesitancy, and falls.

**Conclusion**

In this model (figure 2), the reduction in physical activity (the indirect pathway) due to fear suppresses the counteracting effect of a combination of fragility and hesitancy. Two causal pathways between fear and falls are assumed, with the causal pathway going from Fear of falling via Physical activity to Falls counteracting (is inconsistent with) the causal pathway going from Fear of falling via Hesitancy to Falls. These causal paths operate within a relative small time frame, because in the long term, the protective effect of reduction of physical activity will diminish due to declining abilities.

On the basis of this model, and as suggested by Lacharez et al., the term ‘inconsistent mediation’ might be more appropriate to describe the causal relationships between fear of falling, falls, and physical activity.
Literature
