

## **Development and validation of two physical exercise programme to prevent Hospital associated disability (HAD) during hospitalisation, a protocol of two Delphi studies.**

### **Author:**

Name: Sophie Wist

Email: [sophie.wist@hevs.ch](mailto:sophie.wist@hevs.ch)

Affiliation: School of Health Sciences, HES-SO Valais-Wallis, Leukerbad, Valais-Wallis, 3954, Switzerland.

Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Rehabilitation Research (RERE) Research Group, Vrije Universiteit Brussel, Brussels, Belgium.

### **Author:**

Name: Jan Taeymans

Email: [jan.taeymans@bfh.ch](mailto:jan.taeymans@bfh.ch)

Affiliation: Division of Physiotherapy, Department of Health Professions, University of Applied Sciences Bern, Bern, Switzerland. Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium.

### **Author:**

Name: Katia Giacomino

Email: [katia.giacomino@hevs.ch](mailto:katia.giacomino@hevs.ch)

Affiliation: School of Health Sciences, HES-SO Valais-Wallis, Leukerbad, Valais-Wallis, 3954, Switzerland. Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Rehabilitation Research (RERE) Research Group, Vrije Universiteit Brussel, Brussels, Belgium.

### **Author:**

Name: Roger Hilfiker

Email: [roger.hilfiker@pm.me](mailto:roger.hilfiker@pm.me)

Affiliation: Independent researcher at Englisch-Gruss-Strasse 32, Haus Euklid, 3902 Glis.

### **Author:**

Name: David Beckwée

Email: [David.Beckwee@vub.be](mailto:David.Beckwee@vub.be)

Affiliation: Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Rehabilitation Research (RERE) Research Group, Vrije Universiteit Brussel, Brussels, Belgium.

### **Author:**

Name: Martin Karl Sattelmayer

Email: [martin.sattelmayer@hevs.ch](mailto:martin.sattelmayer@hevs.ch)

Affiliation: School of Health Sciences, HES-SO Valais-Wallis, Leukerbad, Valais-Wallis, 3954, Switzerland.

**DOI:** 10.5281/zenodo.17524197

## Summary

**Background:** Hospitalised older people are prone to rapid functional decline due to a lack of activity; a phenomenon known as hospital-associated disability (HAD). Exercises have a more positive impact on the functional independence and physical performance of older hospitalised patients than usual care. However, the details of the exercises and their modalities are frequently insufficiently detailed to be implemented effectively in clinical practice

**Aim:** The aim of this project is to use the findings of an ongoing living systematic review with network-meta-analysis to reach a consensus on the two training programmes for hospitalised older patients that have been shown to be the most effective. One programme will involve resistance training exercises, while the other will be a multicomponent exercise programme of combined balance, resistance, and gait training. The analysis of each training programme will be conducted in two distinct Delphi studies: one focusing on resistance training and the other on balance, resistance and gait training.

**Methodology:** A modified Delphi study design to reach a consensus among 30 participants will be used. Clinicians, prescribing physical exercises to older adults and researchers in these fields will be invited to participate. Our two studies will each consist of three modified Delphi rounds, using only electronic surveys.

**Potential significance:** These two studies are part of a broader project aimed at improving access to recent scientific evidence on the prevention of HAD in older adults for both clinicians and their patients. These studies will inform the development of clinical training programmes for geriatric hospitals in Switzerland.

**Keywords:** Physical exercises programme, hospital-associated disability, older adults, prevention

## **Study protocol**

### **1. Study context**

In the context of scientific research, the effects of exercise programmes are regularly subject to rigorous testing, including through meta-analysis, thereby providing a robust foundation of scientific knowledge. It is unfortunate that the description of the programmes frequently exhibits a lack of precision, thus impeding the capacity of clinicians to implement them in clinical practice. The SHADE (PhySical Interventions to prevent and reHabilitate hospitAl-associated disability in hospitalised oldEr people) project is driven by the objective of providing adequate and feasible solutions to clinicians, informed by the most current knowledge. This project has been granted financial support from the Swiss National Science Foundation. The initial phase of the project entailed conducting a living systematic review with network-meta-analysis (LSR). This phase is still ongoing and the results have not been published to this date (Giacomino et al., 2025). The present LSR included, in October 2025, 84 randomised controlled trials (RCTs). The primary objective of this LSR is to analyse the effectiveness of various types of physical exercises in preventing and rehabilitating hospital-associated disability in hospitalised older adults, in comparison with usual care. The subsequent phase of this project is to formulate a consensus on the two most effective exercise interventions to be implemented in an acute hospital setting, using a Delphi methodology. Consequently, it is necessary to conduct two Delphi studies, one for each of the two most effective physical exercise training programmes. The following protocol will be used to present this part of the project

### **2. Background**

As people grow older, they are prone to functional decline and the risk of becoming disabled in activities of daily living (ADL) increases (Jagger et al., 2001). Older people who engage in two hours of moderate physical activity on a daily basis, incorporating both aerobic and strength component, demonstrate a significant reduced risk of developing a disability (Landi et al., 2007). Physical activity is defined by the WHO as “any bodily movement produced by skeletal muscles that requires energy expenditure”, in comparison, exercise describes a planned, structured and repeated physical activity, executed in order to improve or maintain physical fitness (Dempsey, 2020).

In Switzerland, in 2023, people aged over 65 years, represented 43.9% of all hospitalisations (Bundesamt für Statistik, 2024). This population is characterised by a high burden of comorbidities and chronic conditions, coupled with reduced physiological reserves, making them especially susceptible to adverse health outcomes (Lafont et al., 2011).

Approximately one third of older adults experience a functional decline during hospitalisation or acute illness (Giacomino et al., 2023; Hartley et al., 2022; Valenzuela et al., 2020). This functional decline is not only related to the disease for which they were admitted but also persists after it has been cured (Creditor, 1993). Various factors associated with functional decline during hospitalisation have been identified, and categorised into three groups: pre-existing patient frailty, the severity of the condition that led to hospitalisation, and the hospitalisation itself (Lafont et al., 2011). Hospital-associated disability (HAD) has been defined as the loss of independence of a patient in at least one activity of daily living (ADL) in individuals who are or were hospitalised (Covinsky et al., 2011). This decline in ADL can lead to longer hospital stays, increased nursing home placement, and increased mortality in such patients (Lafont et al., 2011; Mateev et al., 1998).

A lack of physical exercise among hospitalised older adults could negatively impact HAD (Covinsky et al., 2011; Lafont et al., 2011; Valenzuela et al., 2020). A systematic review with meta-analysis including seven studies have shown that hospitalised patients spend 87-100% of the day sitting or lying in bed (Fazio et al., 2020). They also concluded that hospitalised patients from different wards monitored over the course of a 24-hour period, walked or stood for between 57 and 83 minutes per day (Fazio et al., 2020). By contrast, a study including 432 community dwelling older people found that they were active for around 7.8 hours per day (Cabanas-Sanchez Veronica, 2019). Even in healthy adults under 50 years old, a short stay of around five days in an acute ward followed by prolonged bed rest can have a negative impact on muscle strength (Marusic et al., 2021). The World Health Organization (WHO) recommends that older people engage in at least 150 to 300 minutes of moderate-intensity physical activity, or 75 to 150 minutes of vigorous-intensity physical activity per week, and should minimize their sedentary behaviour for overall health benefits (Dempsey, 2020). These recommendations also included muscle-resistance exercises twice per week, as well as multi-component training three times per week (Dempsey, 2020).

Physical exercise programmes, such as those used for rehabilitation, have been shown to have a more positive impact on the functional independence and physical performance of older hospitalised patients than usual care (Hartley et al., 2022; Valenzuela et al., 2020). In their systematic review with dose-response network-meta-analysis, Gallardo-Gómez et al. (Gallardo-Gómez et al., 2023) demonstrated that meaningful functional improvements in acutely hospitalised older adults can be achieved with approximately 50 minutes per day of slow-paced walking or 40 minutes per day of multicomponent exercises, such as a combination of resistance and aerobic training. As this is a topic of high importance and the available literature is constantly evolving, there is a need for an efficient, specific training pathway, founded on a large body of scientific research, that could easily be implemented in hospitals. It is increasingly important nowadays to translate scientific knowledge into clinical practice. This entails the description of the selected exercises, the modalities to be used, the safety parameters to be observed and the facilitator to be implemented. To help bridge this gap, this present project aims to apply the findings of an ongoing living systematic review with network-meta-analysis (Giacomino et al., 2025) to reach a consensus, using a Delphi methodology, on two training programmes to prevent or reduce HAD in acutely hospitalised older patients. The living systematic review with network-meta-analysis, as well as the two planned Delphi studies, are part of the SHADE project.

The ongoing living systematic review with network-meta-analysis has shown that resistance training alone or a combined resistance, balance, and gait training are the most effective forms of physical exercise to prevent patients against HAD in a hospital setting.

### **2.1. Training programme 1: Resistance training**

A reduction in physical activity of a patients due to bed rest or hospitalisation for around 10 days can result in a loss of approximately 15% of maximal strength and 4-10% of lean tissue mass in the legs, as well as a tendency for an increase in truncal fat tissue (Breen et al., 2013; Suetta et al., 2009). During the first two days of hospitalisation, a loss of 6% of strength can occur in patients (Hartley et al., 2021).

A systematic review has shown that resistance training effectively increases muscle strength in adults over 50 with sarcopenia, a condition directly associated with reduced autonomy in activities of daily living (Cruz-Jentoft et al., 2014). The ongoing SHADE network meta-analysis has shown that, among all types of physical exercise, resistance training is currently one of the most effective interventions for preventing hospital-associated disability (HAD) in older adults at

discharge. It has consistently demonstrated positive results across all analyses. (Giacomino et al., 2025).

Several studies included in the SHADE living systematic review based their interventions on existing multicomponent exercise programmes, such as the Vivifrail physical exercise programme (Izquierdo, 2019), High Intensity Functional Exercise (HIFE) Training (Kastner et al., 2017), and the Otago exercise programme (Campbell et al., 1997; Izquierdo, 2019; Kastner et al., 2017). These programmes served as a foundation for selecting specific exercises. Researchers then used these selections to develop their own bespoke training programmes (Braun et al., 2019; Fountotos et al., 2023; Martínez-Velilla et al., 2019). Some studies used power training, or high-velocity training, which involves a higher speed in the concentric movement of a resistance exercise (Braun et al., 2019; Cadore et al., 2023; Martínez-Velilla et al., 2019). This type of training has been shown to be more effective than resistance training exercises at moderate velocity on the physical function of older people (Balachandran et al., 2022; da Rosa Orssatto et al., 2019; Tschopp et al., 2011). However, there is no evidence that high-velocity training has an impact on ADL for hospitalised older people. In addition, the studies did not describe how to instruct these modalities to patients. They also lacked guidance on which patient groups might benefit most from the intervention. To describe precisely resistance training modalities, it has been recommended among others, to describe the exercise selection, the training frequency and length, the intensity, the number of repetitions and the set endpoint, the number of exercises, the progression, the fractional and temporal distribution of the contraction modes per repetition, the time under tension and its range of motion (Lin et al., 2023; Toigo & Boutellier, 2006). None of the included studies in the LSR contain all these modalities.

## **2.2. Training programme 2: Multicomponent exercise programme including balance, resistance and gait training**

Multicomponent exercise programmes are well established in geriatric care. Such programmes have been shown to have a positive influence on strength and balance, which can subsequently reduce the fear of falling. This fear is a factor that correlates with both the risk of falls and limitations in ADL (Sherrington et al., 2019). Such multicomponent exercise programmes have also been shown to reduce HAD and adverse events associated with hospitalisation (Gallardo-Gómez et al., 2023).

The SHADE ongoing living systematic review with network-meta-analysis, which actually includes 84 studies, has shown that multicomponent exercise programmes, including balance, resistance, and gait training, are the second most effective type of physical exercise training types to prevent HAD in older patients in an acute hospital setting (Giacomino et al., 2025).

The multicomponent exercise programmes included in the SHADE network-meta-analysis comprised balance, resistance and gait training and showed considerable variation in design and implementation. Balance exercises typically included standing balance training on stable or unstable surfaces, as well as seated balance exercises tailored for patients with reduced physical capacity (Fountotos et al., 2023; Jones et al., 2006; Sandberg et al., 2024). Resistance training was performed as mentioned for resistance training above. Gait training mostly involved walking, either with or without supervision, and with or without a walking aid in the hospital corridors (Martínez-Velilla et al., 2019; Ortiz-Alonso et al., 2020; Sandberg et al., 2024). Other walking exercises described in the systematic review included stepping practice and navigating small obstacles (Cadore et al., 2023; Stevens-Lapsley et al., 2016). The multicomponent exercise programmes presented in these studies did not specify the methods used to determine the

appropriate proportion of each component to be included. Nor did they explain how the exercises and their load was adapted to suit different patient types or the safety measures that should be implemented.

### **3. Aim**

This project aims to design and validate two physical exercise programmes, including their modalities, safety parameters and facilitator and barriers, based on the highest current level of evidence. This evidence was established through an ongoing living systematic review with network-meta-analysis, which defined, in October 2025, resistance training as well as a multicomponent exercise programme combining balance, resistance and gait training as two of the most effective exercises interventions, through different analysis, compared to usual care to prevent HAD in older acutely hospitalised patients (Giacomino et al., 2025).

To ensure the practical relevance and applicability of the findings, the development process will include a structured, consensus-building approach involving professionals with expertise, using a modified Delphi method. The latter aims to establish a consensus on the validation of a series of specific exercises designed to prevent hospital-associated disability (HAD) in patients. These exercises target individuals currently in an acute hospital setting or those recently discharged. Agreement should be reached on the modalities of these exercises, including the training frequency, duration, volume, optimal load and speed. There will be two separate modified Delphi studies. The first one will focus on resistance training while the second will focus on a multicomponent programme with a combined balance, resistance and gait training.

## **4. Methods**

### **4.1. Study design**

For our research, we will use a modified Delphi study design (Trevelyan & Robinson, 2015). This project is separated in two distinct Delphi studies, one per exercise programme: one focusing on resistance training and the other on a multicomponent exercise programme combining balance, resistance and gait training. This will enable us to reach a consensus on two exercise programmes designed to prevent HAD in patients in an acute hospital setting. This design is recognised as useful for evidence-based practice, as it facilitates the incorporation of existing knowledge into practical guidelines (Sandrey & Bulger, 2008). Our approach is modified from the typical Delphi study in that not all questions in the first round will be open-ended. This will allow to utilise the knowledge acquired in the network-meta-analysis (Giacomino et al., 2025).

### **4.2. Sampling**

Participants for both Delphi studies (i.e. resistance training only and multicomponent programme with a combination of balance, resistance and gait training) will be recruited using a non-probability purposive sampling method.

### **4.3. Sample size**

We consider the sample of participants to be homogeneous, since they will all be clinicians or researchers working with older people. A sample size of 10 to 15 participants are considered adequate for a homogeneous group (Skulmoski et al., 2007). We plan to include 30 participants per type of training programme (i.e. resistance training and a multicomponent exercise

programme combining balance, resistance and gait training). A sample size of approximately 30 participants per group should ensure the generalisability of the results, even with a dropout rate of up to 20% (Fernandes et al., 2013; Trevelyan & Robinson, 2015).

#### **4.4. Participant recruitment**

The participants on the expert panel will be clinicians, mostly, from various regions of Switzerland, including physiotherapists and sports scientists who actively instruct physical exercise to older people. Snowball recruitment will be conducted. To recruit physiotherapists working in hospitals and rehabilitation centres, we will contact the heads of the medical and therapeutic services at university hospitals and geriatric rehabilitation centres in Switzerland, asking them to forward our email to their employees. To recruit physiotherapists in private practice, we will ask the two Swiss physiotherapy associations, Physioswiss and the Swiss Association of Independent Physiotherapists (ASPI), to circulate an email to their members. We will also contact the Physiotherapy Rehabilitation Community of Interest to find potential experts in different fields. We will proceed in the same way with the Swiss Associations of Professionals in Adapted Sports Activities (ASP-APA and Sportwissenschaft.ch). To ensure that we contact a wide range of people working in these fields, we will also contact Swiss associations active in Health Sport and Sports Therapy, such as Le Réseau Santé & Sport (LRSS), Allianz Bewegung, Sport und Gesundheit, Pro Senectute, Public Health Schweiz, Swissheart and Swisscardiotherapists. To approach Swiss researchers in this field, we will contact alumni and collaborators of universities working in this area and identify researchers through published articles. For all categories, we also will use our professional network in an attempt to increase participation rates.

#### **4.5. Inclusion criteria for participant selection**

These two modified Delphi studies will be open to clinicians who instruct physical exercise to older people (over 65 years old) in facilities such as hospitals, rehabilitation centres, and private practices such as physiotherapists and sports scientists. Participants must have worked with this population for at least five years (Robertson et al., 2017). Researchers specialising in geriatrics and physical exercise with at least three publications in this field will also be eligible (Robertson et al., 2017). As the questions will be asked in English, participants should be able to understand basic written English to participate.

#### **4.6. Establishment of the modified Delphi rounds**

In each modified Delphi study (i.e. resistance training only and multicomponent exercise programme with a combination of balance, resistance and gait training), we will conduct three rounds, as conducting between two and three rounds is recommended to avoid participant fatigue and ensure the relevance of the results (Trevelyan & Robinson, 2015). To minimise attrition, we will keep the interval between the closure of one round and the start of the next as short as possible (Trevelyan & Robinson, 2015). We will also send two participation reminders per round until the deadline. The investigator team will use the browser-based research electronic data capture (REDCap) software (Harris et al., 2009) to develop the questionnaires for the three rounds, focusing on developing questions designed to achieve the objectives of each round. This software will also be used to gather and store the data. The questionnaires will be the same for all participants of one Delphi study.

#### 4.6.1. Round 1

The main aim of the modified Delphi round 1 will be to collect participants' perspectives on the appropriateness of the exercise interventions reported in the ongoing living systematic review (Giacomino et al., 2025). The secondary aim will be to evaluate the levels of patient functional ability for which these interventions are appropriate, and to generate progression possibilities and safety measures for each level. Additionally, we will explore further exercise options and establish a consensus on feasible implementation modalities. A last aim of this first modified Delphi round will be to establish a list of facilitators and barriers of training in a hospital setting, on a clinician and patient view.

First participants will be informed about the scientific knowledge gathered in the LSR regarding physical exercise interventions to prevent HAD in hospitalised older patients. Then, their personal data will be collected. Second, participants will be asked to analyse the exercises identified in the studies included in our network-meta-analysis for their appropriateness in a hospital setting in Switzerland with older adults of different ability levels. We will then ask them to identify further appropriate exercises for this training concept (i.e. resistance or multicomponent programme). Each exercise will be described by its name, starting position, movement pattern, and instructions. For all exercises, the participants should explain how they would adapt them for patients with different ability levels, and which safety parameters should be included in the description. During the first round, we will also ask participants to define the appropriate load for a given ability level in such hospitalised patients aged over 65 years. Similarly, we will seek expert consensus on training frequency, duration, exercise volume and proportion and timing of the contractions, as well as exercise type to evaluate their appropriateness for patients of different ability levels. Finally, the volunteering clinicians and researchers will be asked to identify the facilitators and barriers to implementing such exercise programmes for the prevention of HAD in older adults in a hospital setting.

Due to the wide range of patients' needs and capacities, we will use a predetermined classification system for patients based on the three-level dependency scale of the commonly used Barthel Index. This scale categorises patients as "severely dependent patient", "moderately dependent patient" or "slightly dependent or independent patient" (Ocagli et al., 2021; Saxena et al., 2006). To facilitate responses, these different ability levels categories will be defined descriptively rather than by specific point thresholds on the Barthel Index:

- Severely dependent: patient is unable to perform any or most ADLs without substantial help
- Moderately dependent: patient can perform several ADLs independently or with minimal help
- Slightly dependent or independent: patient is mostly independent

In the first round of the present modified Delphi study, exercises consensus questions will be presented using a Likert item with a six-point ordinal scale to minimise questionnaire length and reduce the risk of participants dropping out. Additionally, open-ended questions will be included to clarify sources of disagreement, identify missing exercises and explore possibilities regarding exercise modalities. Based on the results obtained, we will: i) compile a pool of potentially relevant exercises, ii) define a set of modalities for a preliminary exercise programme and iii) compile a pool of potential facilitators and barriers to implementing such exercise programmes for the prevention of HAD in older adults in a hospital setting.



#### **4.6.2. Round 2**

The second rounds of the modified Delphi study will aim to collect the participants' opinion on the developed physical exercise programmes. To this end, we will present the results of the first round to the participants. For the consensus questions, the results will be summarised using the median and interquartile range (IQR) of the participants' ratings. The key themes and concepts identified through the open-ended responses will be organised systematically and presented in a structured manner.

Participants will be asked to indicate their level of agreement with the proposed exercises, their progression and safety measures using a Likert item with a six-point ordinal scale. Participants will then be asked to do the same with the modality descriptions and the facilitators and barriers to implementing such exercise programmes for the prevention of HAD in older adults in a hospital setting. In case of disagreement, volunteering clinicians will be invited to suggest modifications or propose alternative approaches. The same question types as in round 1 (i.e. agreement questions using Likert item with a six-point ordinal scale and open text questions will be used to clarify disagreement).

#### **4.6.3. Round 3**

The aim of the third modified Delphi study round is to gather participants' opinions on the revised physical exercise programme, modalities, facilitators and barriers to implementing such exercise programmes for the prevention of HAD in older adults in a hospital setting. The results of the consensus questions from round two will therefore be presented with summary statistics such as medians and IQR to the participants. Any elements that fail to reach consensus will be adapted and re-evaluated using the same procedure as in round two.

#### **4.7. Data collection**

The electronic data collection system REDCap (Harris et al., 2009) will be used to collect and manage study's data. REDCap surveys will first be tested by team members and colleagues not involved in developing the questions. This will provide feedback on completion time and comprehensibility. The surveys will then be adapted and sent to the participants via email. Participants' identities will be coded, and access to these data will be restricted to the three main investigators, two bachelor students and one master student. All participants' contact information will be permanently deleted upon completion of the study.

#### **4.8. Data analysis**

The data from the modified Delphi studies will be reported in accordance with the reporting guidelines for Delphi techniques in health sciences, as proposed by Spranger et al. (Spranger et al., 2022).

We will use a Likert item with a six-point ordinal scale, as this lies between the four and seven categories that have been considered as optimal (Trevelyan & Robinson, 2015). Given that the participants are assumed to represent a homogeneous group with sufficient knowledge to answer all questions, a neutral 'don't know' response option will not be provided. This decision aims to encourage participants to take a position on each item, thereby supporting the consensus-building process.

#### **4.8.1. Quantitative analysis of the modified Delphi study rounds**

The characteristics of the participants, including their work setting, primary training, years of experience, age, and sex, will be presented in a table using mean values and their standard deviation. The number of participants in each round of the modified Delphi studies will be presented using a participant flow diagram. This diagram will visually represent participant retention and attrition across the different modified Delphi rounds.

##### **4.8.1.1. Level of agreement**

In this study, consensus will be defined as the level of agreement, which will be measured as follows: A Likert item with a six-point ordinal scale will be used to assess participants' agreement or disagreement with each question in the questionnaire. Participants will be asked to indicate their level of agreement on a scale from 1 to 6 (1 = Very strongly agree, 2 = Strongly agree, 3 = Agree, 4 = Disagree, 5 = Strongly disagree, and 6 = Very strongly disagree). During the analysis phase, the Likert item with a six-point ordinal scale will be dichotomised as suggested by Limotai et al. (2020) as follows:

- i) responses 1 to 3 will be considered positive
- ii) responses 4 to 6 will be considered negative

Our a priori criterion will be as follows: if more than 80% of participants agree with a statement, we will assume that they are in favour of it, and it will be included in the final version of the training programme. Statements (e.g. type of exercise, duration, frequency, safety measures) will be included if approved by 80% of participants (Likert item: 1-3) and excluded if disapproved (Likert item: 4-6) by 50% of participants after each rounds of the modified Delphi studies (Minkman et al., 2009). All intermediate values will be included in the next round. We will also show the trend in the distribution by providing the median and IQR for each task.

Any data that has not have reached an agreement by the end of the three rounds will be presented separately, using the results from the third round.

##### **4.8.1.2. Stability of response/internal reliability**

The stability of responses (i.e. referring to the level of agreement between rounds in the modified Delphi study and serving as a measure of reliability) will be reported using the median and interquartile range (IQR) across rounds. The stability of results, will be determined using a Wilcoxon matched-pairs signed-rank test (Trevelyan & Robinson, 2015).

#### **4.8.2. Qualitative analysis of the different modified Delphi study rounds**

For the open-ended questions, we will summarise the responses to each open question. Similar suggestions will be grouped together and ordered by frequency (Hollaar et al., 2016). Two investigators will carry out this step separately and their results will be compared. If there is persistent conflict, a third person will intervene and make the final decision. The research group will then meet to decide which elements to include or exclude in the next round.

### **5. Ethical committee**

This study was reviewed by the Cantonal Research Ethics Commission of Vaud (CER-VD), Switzerland, following a request for clarification (Req-2025-00928). The Commission confirmed that the project does not fall under the scope of the Swiss Federal Human Research Act (HRA). As such, authorisation from an ethics committee is not required. The study does not involve the

collection of health-related data, and all procedures comply with applicable ethical standards for research not subject to the HRA.

## 6. References

- Balachandran, A. T., Steele, J., Angielczyk, D., Belio, M., Schoenfeld, B. J., Quiles, N., Askin, N., & Abou-Setta, A. M. (2022). Comparison of power training vs traditional strength training on physical function in older adults: a systematic review and meta-analysis. *JAMA network open*, 5(5), e2211623-e2211623.
- Braun, T., Grüneberg, C., Süßmilch, K., Wiessmeier, M., Schwenk, I., Eggert, S., Machleit-Ebner, A., Harras, I., & Thiel, C. (2019). An augmented prescribed exercise program (APEP) to improve mobility of older acute medical patients—a randomized, controlled pilot and feasibility trial. *BMC geriatrics*, 19(1), 240.
- Breen, L., Stokes, K. A., Churchward-Venne, T. A., Moore, D. R., Baker, S. K., Smith, K., Atherton, P. J., & Phillips, S. M. (2013). Two Weeks of Reduced Activity Decreases Leg Lean Mass and Induces “Anabolic Resistance” of Myofibrillar Protein Synthesis in Healthy Elderly. *The Journal of Clinical Endocrinology & Metabolism*, 98(6), 2604-2612. <https://doi.org/10.1210/jc.2013-1502>
- Bundesamt für Statistik, B. (2024). *Patienten in Spitälern nach Altersklasse, Geschlecht und Diagnosegruppe (2003–2023)* (<https://www.bfs.admin.ch>)
- Cabanas-Sanchez Veronica, H.-F. S., De La Camara Miguel Angel, Esteban-Cornejo Irene Martinez-Gomez David. (2019). 24-h Movement and Nonmovement Behaviors in Older Adults. The IMPACT65+ Study. *Medicine & Science in Sports & Exercise*, 51(4), 671-680. <https://doi.org/10.1249/mss.0000000000001838>
- Cadore, E. L., Izquierdo, M., Teodoro, J. L., Martínez-Velilla, N., Zambom-Ferraresi, F., Moriguchi, E. H., & Sáez de Asteasu, M. L. (2023). Effects of short-term multicomponent exercise intervention on muscle power in hospitalized older patients: A secondary analysis of a randomized clinical trial. *Journal of Cachexia, Sarcopenia and Muscle*, 14(6), 2959-2968.
- Campbell, A. J., Robertson, M. C., Gardner, M. M., Norton, R. N., Tilyard, M. W., & Buchner, D. M. (1997). Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. *Bmj*, 315(7115), 1065-1069.
- Covinsky, K. E., Pierluissi, E., & Johnston, C. B. (2011). Hospitalization-associated disability: "She was probably able to ambulate, but I'm not sure". *Jama*, 306(16), 1782-1793. <https://doi.org/10.1001/jama.2011.1556>
- Creditor, M. C. (1993). Hazards of hospitalization of the elderly. *Ann Intern Med*, 118(3), 219-223. <https://doi.org/10.7326/0003-4819-118-3-199302010-00011>
- Cruz-Jentoft, A. J., Landi, F., Schneider, S. M., Zúñiga, C., Arai, H., Boirie, Y., Chen, L.-K., Fielding, R. A., Martin, F. C., & Michel, J.-P. (2014). Prevalence of and interventions for sarcopenia in ageing adults: a systematic review. Report of the International Sarcopenia Initiative (EWGSOP and IWGS). *Age and ageing*, 43(6), 748-759.
- da Rosa Orssatto, L. B., de la Rocha Freitas, C., Shield, A. J., Pinto, R. S., & Trajano, G. S. (2019). Effects of resistance training concentric velocity on older adults' functional capacity: A systematic review and meta-analysis of randomised trials. *Experimental Gerontology*, 127, 110731.
- Dempsey, P. (2020). WHO guidelines on physical activity and sedentary behaviour. In: Deakin University.
- Fazio, S., Stocking, J., Kuhn, B., Doroy, A., Blackmon, E., Young, H. M., & Adams, J. Y. (2020). How much do hospitalized adults move? A systematic review and meta-analysis. *Appl Nurs Res*, 51, 151189. <https://doi.org/10.1016/j.apnr.2019.151189>

- Fernandes, L., Hagen, K. B., Bijlsma, J. W., Andreassen, O., Christensen, P., Conaghan, P. G., Doherty, M., Geenen, R., Hammond, A., & Kjekken, I. (2013). EULAR recommendations for the non-pharmacological core management of hip and knee osteoarthritis. *Annals of the rheumatic diseases*, 72(7), 1125-1135.
- Fountotos, R., Ahmad, F., Bharaj, N., Munir, H., Marsala, J., Rudski, L. G., Goldfarb, M., & Afilalo, J. (2023). Multicomponent intervention for frail and pre-frail older adults with acute cardiovascular conditions: The TARGET-EFT randomized clinical trial. *Journal of the American Geriatrics Society*, 71(5), 1406-1415.
- Gallardo-Gómez, D., del Pozo-Cruz, J., Pedder, H., Alfonso-Rosa, R. M., Álvarez-Barbosa, F., Noetel, M., Jasper, U., Chastin, S., Ramos-Munell, J., & del Pozo Cruz, B. (2023). Optimal dose and type of physical activity to improve functional capacity and minimise adverse events in acutely hospitalised older adults: a systematic review with dose-response network meta-analysis of randomised controlled trials. *British Journal of Sports Medicine*, 57(19), 1272-1278.
- Giacomino, K., Beckwée, D., Gafner, S. C., Wist, S., Hilfiker, R., Taeymans, J., & Sattelmayer, K. M. (2025). Physical exercises to prevent and rehabilitate hospital-associated disability in hospitalised older people: A protocol for a living systematic review with network meta-analysis. *F1000Research*, 14, 414.
- Giacomino, K., Hilfiker, R., Beckwée, D., Taeymans, J., & Sattelmayer, K. M. (2023). Assessment tools and incidence of hospital-associated disability in older adults: a rapid systematic review. *PeerJ*, 11, e16036. <https://doi.org/10.7717/peerj.16036>
- Harris, P. A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. G. (2009). Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*, 42(2), 377-381. <https://doi.org/10.1016/j.jbi.2008.08.010>
- Hartley, P., Keating, J. L., Jeffs, K. J., Raymond, M. J., & Smith, T. O. (2022). Exercise for acutely hospitalised older medical patients. *Cochrane Database Syst Rev*, 11(11), CD005955. <https://doi.org/10.1002/14651858.CD005955.pub3>
- Hartley, P., Romero-Ortuno, R., Wellwood, I., & Deaton, C. (2021). Changes in muscle strength and physical function in older patients during and after hospitalisation: a prospective repeated-measures cohort study. *Age and ageing*, 50(1), 153-160.
- Hollaar, V., van der Maarel-Wierink, C., van der Putten, G. J., van der Sanden, W., de Swart, B., & de Baat, C. (2016). Defining characteristics and risk indicators for diagnosing nursing home-acquired pneumonia and aspiration pneumonia in nursing home residents, using the electronically-modified Delphi Method. *BMC Geriatr*, 16, 60. <https://doi.org/10.1186/s12877-016-0231-4>
- Izquierdo, M. (2019). Multicomponent physical exercise program: Vivifrail. *Nutricion hospitalaria*, 36(Spec No2), 50-56.
- Jagger, C., Arthur, A. J., Spiers, N. A., & Clarke, M. (2001). Patterns of onset of disability in activities of daily living with age. *Journal of the American Geriatrics Society*, 49(4), 404-409.
- Jones, C. T., Lowe, A. J., MacGregor, L., Brand, C. A., Tweddle, N., & Russell, D. M. (2006). A randomised controlled trial of an exercise intervention to reduce functional decline and health service utilisation in the hospitalised elderly. *Australasian Journal on Ageing*, 25(3), 126-133.
- Kastner, S., Becker, C., & Lindemann, U. (2017). High Intensity Functional Exercise (HIFE) Training. *physioscience*, 13(03), 109-116.
- Lafont, C., Gérard, S., Voisin, T., Pahor, M., & Vellas, B. (2011). Reducing “iatrogenic disability” in the hospitalized frail elderly. *The Journal of nutrition, health and aging*, 15(8), 645-660.
- Landi, F., Onder, G., Carpenter, I., Cesari, M., Soldato, M., & Bernabei, R. (2007). Physical activity prevented functional decline among frail community-living elderly subjects in an international observational study. *Journal of clinical epidemiology*, 60(5), 518-524.

- Lin, T.-Y., Chueh, T.-Y., & Hung, T.-M. (2023). Preferred Reporting Items for Resistance Exercise Studies (PRIRES): A Checklist Developed Using an Umbrella Review of Systematic Reviews. *Sports Medicine - Open*, 9(1), 114. <https://doi.org/10.1186/s40798-023-00640-1>
- Martínez-Velilla, N., Casas-Herrero, A., Zambom-Ferraresi, F., de Asteasu, M. L. S., Lucia, A., Galbete, A., García-Baztán, A., Alonso-Renedo, J., González-Glaría, B., & Gonzalo-Lázaro, M. (2019). Effect of exercise intervention on functional decline in very elderly patients during acute hospitalization: a randomized clinical trial. *JAMA internal medicine*, 179(1), 28-36.
- Marusic, U., Narici, M., Simunic, B., Pisot, R., & Ritzmann, R. (2021). Nonuniform loss of muscle strength and atrophy during bed rest: a systematic review. *J Appl Physiol (1985)*, 131(1), 194-206. <https://doi.org/10.1152/jappphysiol.00363.2020>
- Mateev, A., Gaspoz, J.-M., Borst, F., Waldvogel, F., & Weber, D. (1998). Use of a short-form screening procedure to detect unrecognized functional disability in the hospitalized elderly. *Journal of clinical epidemiology*, 51(4), 309-314.
- Minkman, M., Ahaus, K., Fabbricotti, I., Nabitz, U., & Huijsman, R. (2009). A quality management model for integrated care: results of a Delphi and Concept Mapping study. *Int J Qual Health Care*, 21(1), 66-75. <https://doi.org/10.1093/intqhc/mzn048>
- Ocagli, H., Cella, N., Stivanello, L., Degan, M., & Canova, C. (2021). The Barthel index as an indicator of hospital outcomes: A retrospective cross-sectional study with healthcare data from older people. *Journal of Advanced Nursing*, 77(4), 1751-1761.
- Ortiz-Alonso, J., Bustamante-Ara, N., Valenzuela, P. L., Vidán-Astiz, M., Rodríguez-Romo, G., Mayordomo-Cava, J., Javier-González, M., Hidalgo-Gamarra, M., López-Tatis, M., & Valades-Malagón, M. I. (2020). Effect of a simple exercise program on hospitalization-associated disability in older patients: a randomized controlled trial. *Journal of the American Medical Directors Association*, 21(4), 531-537. e531.
- Robertson, S., Kremer, P., Aisbett, B., Tran, J., & Cerin, E. (2017). Consensus on measurement properties and feasibility of performance tests for the exercise and sport sciences: a Delphi study. *Sports medicine-open*, 3(1), 2.
- Sandberg, L., Boström, A.-M., Hagströmer, M., Lindgren, C., Kivipelto, M., Sandlund, C., & Welmer, A.-K. (2024). Feasibility of the “Preventing functional decline in acutely hospitalized older patients (PREV\_FUNC)” study—A three-armed randomized controlled pilot trial. *Plos one*, 19(6), e0304570.
- Sandrey, M. A., & Bulger, S. M. (2008). The Delphi method: an approach for facilitating evidence based practice in athletic training. *Athletic Training Education Journal*, 3(4), 135-142.
- Saxena, S., Ng, T., Yong, D., Fong, N., & Gerald, K. (2006). Total direct cost, length of hospital stay, institutional discharges and their determinants from rehabilitation settings in stroke patients. *Acta neurologica scandinavica*, 114(5), 307-314.
- Sherrington, C., Fairhall, N. J., Wallbank, G. K., Tiedemann, A., Michaleff, Z. A., Howard, K., Clemson, L., Hopewell, S., & Lamb, S. E. (2019). Exercise for preventing falls in older people living in the community. *Cochrane database of systematic reviews*(1).
- Skulmoski, G. J., Hartman, F. T., & Krahn, J. (2007). The Delphi method for graduate research. *Journal of Information Technology Education: Research*, 6(1), 1-21.
- Spranger, J., Homberg, A., Sonnberger, M., & Niederberger, M. (2022). Reporting guidelines for Delphi techniques in health sciences: A methodological review. *Zeitschrift für Evidenz, Fortbildung und Qualität im Gesundheitswesen*, 172, 1-11.
- Stevens-Lapsley, J. E., Loyd, B. J., Falvey, J. R., Figiel, G. J., Kittelson, A. J., Cumbler, E. U., & Mangione, K. K. (2016). Progressive multi-component home-based physical therapy for deconditioned older adults following acute hospitalization: a pilot randomized controlled trial. *Clinical rehabilitation*, 30(8), 776-785.
- Suetta, C., Hvid, L. G., Justesen, L., Christensen, U., Neergaard, K., Simonsen, L., Ortenblad, N., Magnusson, S. P., Kjaer, M., & Aagaard, P. (2009). Effects of aging on human skeletal

- muscle after immobilization and retraining. *Journal of applied physiology*, 107(4), 1172-1180.
- Toigo, M., & Boutellier, U. (2006). New fundamental resistance exercise determinants of molecular and cellular muscle adaptations. *European journal of applied physiology*, 97(6), 643-663.
- Trevelyan, E. G., & Robinson, N. (2015). Delphi methodology in health research: how to do it? *European Journal of Integrative Medicine*, 7(4), 423-428.
- Tschopp, M., Sattelmayer, M. K., & Hilfiker, R. (2011). Is power training or conventional resistance training better for function in elderly persons? A meta-analysis. *Age and ageing*, 40(5), 549-556.
- Valenzuela, P. L., Morales, J. S., Castillo-Garcia, A., Mayordomo-Cava, J., Garcia-Hermoso, A., Izquierdo, M., Serra-Rexach, J. A., & Lucia, A. (2020). Effects of exercise interventions on the functional status of acutely hospitalised older adults: A systematic review and meta-analysis. *Ageing Res Rev*, 61, 101076. <https://doi.org/10.1016/j.arr.2020.101076>