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Exercise and physical activity for health promotion and rehabilitation in community dwelling very old adults or nursing home residents

The aging of the world's population fundamentally affects medical care, health care systems, and society. More specifically, demographic, and societal trends have far-reaching implications for clinical care, medical research, and health care policy. Regular exercise or physical activity as well as an active lifestyle have been shown to influence the intercept, slope, and pace of age-related changes. However, the important role of exercise and physical activity as well as sports science related to physical activity and exercise is still underrepresented in this area of geriatric research.

» Keeping an active lifestyle increases health, prevents disease, and helps to maintain quality of life

Therefore, this special issue primarily publishes studies examining age-related changes of cognitive, perceptual, and motor functions that affect the mobility of older individuals and their activities of daily living. Also, more and more studies investigate quality of life, well-being, education, and other relevant aspects in healthy older adults after retirement, and in very old adults and inhabitants of long-term care facilities. Over the last few decades it has been shown that engaging in different sports and exercise

activities and keeping an active lifestyle increases health, prevents disease, and helps to maintain the quality of life in these target groups.

Three primary pathways to gain positive benefits by sports interventions can be differentiated: (1) physical activity and tailored exercises to increase different outcomes of cognitive and motor fitness, (2) social engagement, psychosocial parameters, and mental health and (3) cognitive stimulation, which is also associated with physical and global functioning (e.g., activities of daily living (ADL), instrumental activities of daily living (IADLs)), cognitive functioning (especially memory and executive functions) as well as increased quality of life (Newsom, Shaw, August, & Strath, 2018; Warburton & Bredin, 2017; Chodzko-Zajko et al., 2009; Smith, Banting, Eime, O'Sullivan, & Van Uffelen, 2017; Kramer & Colcombe, 2018; Brasure et al., 2018).

In this special issue, we use these pathways to structure the presented studies from all disciplines of human movement science as well as areas of motor control and learning, sport and exercise psychology, social psychology and philosophy of human movement, public health, and physical rehabilitation.

Physical activity and tailored exercises to increase different outcomes of cognitive and motor fitness

The main goals for regular exercise in older age are often associated with maintaining physical fitness as well as mobility and independence. The ability to mobilize safely is a key indicator of health and independence in old age because it allows ongoing social participation and prevents falls. Therefore, it is of great interest to identify factors that influence mobility as well as gait pattern and at the same time can be addressed by appropriate training (Cadore, Rodríguez-Mañas, Sinclair, & Izquierdo, 2013; Valenzuela et al., 2020; Vlietstra, Hendrickx, & Waters, 2018). A variety of systematic reviews have confirmed positive effects of physical and balance training on the reduction of risks related to falls, number of falls (Chang et al., 2004; Chan et al., 2015; Sherrington et al., 2020), and benefits for daily activities (Chou, Hwang, & Wu, 2012; Tak, Kuiper, Chorus, & Hopman-Rock, 2013). However, the differentiation within physical activity's subcategories is often unnoticed by other health professionals as well as by older persons. Terms like mobility, physical activity, or sport are differently defined and used in different disciplines and in daily language. Therefore, the article by Freiberger and Notthoff (2021) within

this special issue focuses on exercise as a planned, structured, repetitive program which is often used interchangeably with physical activity (PA). The authors show overlaps between PA and exercise and the relevance of the differences for practice. Moreover, they describe the differences in wording between health care professionals, sport scientists and older lay persons to enhance the understanding for professionals.

While this article has been written as “short communication”, the writing and reviewing process revealed that the elaboration of several aspects and implications of the topic would exceed this article type by far. Thus, authors, reviewers and editors would like to encourage further discussion on this neglected topic, which should also lead to empirical analyses.

A specific idea to enhance PA in older adults are lifestyle-integrated exercises. One successful, internationally intervention is the Lifestyle-integrated Functional Exercise (LiFE) program by Clemson et al. (2012). It integrates physical activity, balance, and strength activities into daily tasks of older adults, with the main goal to reduce falls. However, the overall positive effects of the program led to several adaptations of the original LiFE program to other target groups. Therefore, the second article in this issue by Hezel et al. (2021), provides a first systematic overview of LiFE modifications and their specifications, the current evidence regarding the feasibility and effectiveness, and challenges and potential of those different LiFE modifications. Current studies show strong effectiveness of the original LiFE program in terms of reducing falls, improving motor performance, and increasing PA. Current research focuses also on the challenges (transfer into daily life, appropriate task challenges, technology) and potential (cost-effectiveness, large-scale implementation) of different LiFE modifications and proposes new avenues for adapting LiFE in different target groups and settings.

Nevertheless, there is strong evidence that structured exercise programs in healthy and prefrail older individuals can effectively improve everyday functionality and mobility, while reducing physical

frailty (de Labra, Guimaraes-Pinheiro, Maseda, Lorenzo, & Millán-Calenti, 2015; Giné-Garriga, Roqué-Fíguls, Coll-Planas, Sitja-Rabert, & Salvà, 2014). In addition, the positive effect of regular PA on cognition and on the prevention of diseases (such as cardiovascular diseases, diabetes, osteoporosis, or sarcopenia) has already been demonstrated (e.g., Pasanen, Tolvanen, Heinonen, & Kujala, 2017).

In addition to these general benefits of exercise increasing fitness levels in older age, there is a growing body of evidence that exercise interventions should integrate the specific requirements of the target groups as well as relevant training principles to enlarge the individuals’ adaptation (Erickson et al., 2019; Hecksteden & Meyer, 2018; Herold, Müller, Gronwald, & Müller, 2019). These aspects gained more attention with the German Prevention Act of 2015. It incorporates that German nursing care insurances must provide preventive services in nursing homes that are aiming at promoting the health of residents by maintaining or improving several domains, such as physical functioning and mobility, cognition, and quality of life (GKV-Spitzenverband, 2018). Therefore, a lot of research projects started to develop and to examine new targeted interventions. In this issue, Klotzbier et al. (2021) present preliminary results of a large multicenter approach (Cordes et al., 2019). Within this large randomized controlled trial (RCT), the authors integrated the instrumented Timed-Up-and-Go (iTUG) to observe intervention effects of multicomponent exercises for nursing home residents with respect to attendance rates. The study results showed positive intervention effects of the iTUG, especially when participants exhibit high attendance rates. Regarding these intervention effects one might assume that better physical performance levels will also increase the overall mobility of this target group. However, this transfer cannot be generalized. It is more presumable that inactivity will be observed in nursing home residents, even if they are able to walk independently or with a walking aid.

One of the reasons for this may be limited ability about finding one’s way

around the care facility and its environment. Moreover, most activities of daily living require dynamic integration of sights, sounds, and movements as people navigate through complex environments (Faulkner et al., 2007). Therefore, the effect of dual-task (DT) training on dual-task performance is a growing field of research interest and currently reports overall positive benefits on cognitive–motor performance (e.g., Wollesen, Wildbrecht, van Schooten, Lim, & Delbaere, 2020; Wollesen & Voelcker-Rehage, 2014). Additional studies investigated practice effects of motor–cognitive dual-task management training on DT walking performance (Wollesen et al., 2017a; Wollesen, Schulz, Seydell, & Delbaere, 2017b; Wollesen et al., 2021). Results showed that DT practice, in combination with strategies to maintain or to recover balance and task prioritization strategies led to improved gait quality. Another study by J.S. Brach and colleagues found that task-orientated motor learning enhanced the motor control of walking, whereas standard exercise did not (Brach et al., 2015).

To combine the positive effects of DT managing training with orientation aspects, a study by Fricke et al. (2021) present an innovative program in this issue. They integrated six novel and target group-specific spatial orientation exercises into an established DT multicomponent training for nursing home residents and evaluated their feasibility. Additionally, the authors assessed the training’s preliminary impact on mobility and life satisfaction. Next to the positive results, this article shows relevant materials and necessary steps when conducting a targeted intervention.

Social engagement, psychosocial parameters, and mental health

Three articles of the current issue deal with this pathway.

First, sociopsychological aspects of demographic change and their consequences on healthy aging are reflected within the qualitative interview study by Sobiech & Leipert (2021). The authors do not define age(ing) in the light of

immutable changes, but as something more adaptable. They refer to healthy lifestyles, which aim at the self-responsible management of physical risks through fitness and discipline and the individuals' ability to expand their freedom of action. Their study examined the question of how older women in Germany and America, who are active in fitness gyms, position themselves in relation to social discourses of successful age(ing), how they take these up in their body concepts and practices, and finally, how they judge bodies that differ from fitness ideals.

Regarding the psychological well-being of nursing home residents, group-based physical activity adds high and long-term value to these participants. In the second study, Wolter, Dohle & Sobo (2021) contribute to the idea of interdisciplinary thinking and the networking of local structures (e.g., sports clubs). Their project helps local sports clubs to collaborate with providers of outpatient and inpatient care to start new sports programs. The authors report on findings of qualitative interviews with representatives of sports clubs with the focus on chances and barriers for local partnerships between sport clubs and care. The study contributes to our understanding of the relationship between exercise, physical activity, and health on the individual level, but also on the community level, and across all sectors

In addition to these practical implications, the study by Schoot, Johnen & Klotzbier (2021) provides the translation and validation of the Laurens Well-Being Inventory for Gerontopsychiatry (LWIG), an instrument for another relevant aspect with age-related research. The cross-sectional, descriptive study design was conducted with $N=104$ long-term nursing home residents ($f=57$, $m=47$) aged 60 to 99 years (mean: 79.5, SD: ± 9.11). The final German version of the LWIG consists of 19 items with three subscales: psychological well-being (WB), social WB, and physical WB. The LWIG-GER showed good overall reliability with McDonald's ω of 0.83; the LWIG-GER dimensions' scores were significantly correlated with depression, functional performance, activities, falls

anxiety, and education. Therefore, the authors conclude that the German language version of the LWIG is a reliable and valid tool for measuring WB in nursing home residents and believe that the LWIG-GER questionnaire can broaden and deepen our understanding of residents' perception of quality of care and their environment.

Cognitive stimulation to increase global, physical, and cognitive functioning

There is a lot of evidence showing that engaging in a physical active lifestyle prevents cognitive decline and for example neuropsychiatric symptoms like depression in later life. These aspects were addressed within the longitudinal study by Krell-Rösch et al. (2021) within this issue. Their prospective cohort study with >3000 cognitively unimpaired persons aged ≥ 50 years (1570 males; 74 years median age) examined the consequences of the lack of engaging in light, moderate, and vigorous intensity PA and the presence of neuropsychiatric symptoms (agitation, anxiety, apathy, appetite change, sleep/nighttime disturbance, depression, irritability, clinical depression, clinical anxiety). The study showed that after a median follow-up of 6.3 years, 599 participants developed incident mild cognitive impairment (MCI). Not engaging in vigorous intensity PA and having sleep or nighttime disturbance, clinical depression or clinical anxiety was associated with an increased risk of incident MCI. The results underpin the relevance of regular physical exercise to maintain mentally and cognitively fit with increasing age.

The study by Prinz et al. (2021) refers to one of the most common causes of the need for care in old age: dementia. It has been predicted that different forms of dementia will be responsible for around 60% of the admissions to nursing homes. To ensure that people with dementia enjoy a pleasant retirement despite their need for care, it is important to develop ways of preserving their cognitive and motor skills, thus enhancing their quality of life. Prinz et al. based their approach on studies indicating that

a combination of PA and music has positive effects on dementia patients. Therefore, the aim of their study was to develop a music-based exercise program for people with dementia and analyze its influences on cognitive and motor skills as well as quality of life. Thus, 49 dementia patients were divided into an intervention group ($n=32$) and a control group ($n=16$). The intervention group performed a multidimensional music-based exercise program over 12 weeks, while the control group received the usual treatments. The intervention group improved in hand grip strength, mobility, and balance after 3 months, whereas the control group deteriorated in many parameters. Also, cognitive parameters, e.g. executive functions, were enhanced by the intervention. The multidimensional music-based exercise program was well received by the target group. Therefore, the authors conclude that music-based exercise programs may be a promising addition to medication therapies.

Another program with the aim to increase activities of daily living in individuals with dementia was conducted by Bezold et al. (2021) and is reported in this issue. In their 16-week multimodal intervention within a multicenter randomized controlled trial involving 319 participants aged ≥ 65 years with mild to moderate dementia, they investigated the participants' individual response to the exercise program and whether baseline cognitive and motor performance explain activities of daily living performance. The authors also compared baseline cognitive and motor performance between positive-responders, non-responders, and negative-responders. They examined cognitive and motor performance as potential cofounders of activities of daily living by conducting multiple regression analyses. The results showed no significant $\text{time} \times \text{group}$ effects on activities of daily living. However, 20–32% of participants responded positively to the intervention, i.e., improved activities of daily living performance from baseline to follow-up. The positive responders had worse baseline motor performance compared to non-responders. Cognitive and motor

performance explained up to 51.4% of variance in activities of daily living.

Unfortunately, the multimodal exercise program had no significant overall effect on activities of daily living in individuals with dementia. Therefore, the authors recommend that future research should focus on the individualization of physical exercise programs considering heterogeneous characteristics of individuals with dementia.

Summary and future directions

As this special issue is the result of an open call on a specific subject, the contributions were not expected to cover the topic systematically. Instead, we present a variety of studies: Regarding the “pathways” above, four papers relate to (1) physical activity and tailored exercises to increase different outcomes of cognitive and motor fitness, three papers to (2) social engagement, psychosocial parameters, and mental health and three papers to (3) cognitive stimulation, which is also associated with physical and global functioning. Most of the papers relate to preparation (Fricke et al., 2021; Wolter et al., 2021; Prinz et al., 2021) and conduction (Hezel et al., 2021; Bezold et al., 2021) of specified interventions. Two papers deal with the development and validation of instruments (Klotzbier et al., 2021; Schott et al., 2021). Two studies observed ageing cross-sectionally (Sobiech et al., 2021) and as development (Krell-Rösch et al., 2021) in relation to PA, exercise and corresponding attitudes.

Such a broad spectrum is typical for sport science as well as for gerontology. Certainly, a summary in a few lines is not possible. Instead, we want to point out two observations:

- Over the years, we observe a development to more precise descriptions and definitions, more diversity and combinations of methods, more willingness to include views and feedback from “scientific neighborhoods” in our field.
- However, the amount and different levels of complexity both of interventions (e.g., exercise, session, all-day behavior levels) and of effects (e.g., movement parameters, behav-

ior and activity components, health factors) still seems to be the largest challenge for designing research and interpreting the results in our field.

Both observations require specific activities in order to communicate and to cooperate trans- and interdisciplinarily. Examples for such a focus on science as such could be:

- Short overviews to prepare a certain topic or method for scientists from other disciplines or fields.
- Work on a common language or at least on certain terms, which are jointly usable (as an initiative, see Freiburger & Notthoff 2021 in this issue)
- Standardization for better comparison of results, at first within one’s own field, then across fields—at least possibilities and limits of comparability should be assessed.

The editors are convinced that networking and cooperating is key to further developments, more than just continuing current paths and finding new topical directions of research. The editors of this issue would like to thank all authors and reviewers for their contributions and fruitful discussions.

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