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## Barriers, motivators, and facilitators of physical activity in dementia patients

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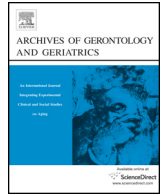
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## Review

# Barriers, motivators, and facilitators of physical activity in dementia patients: A systematic review



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## ABSTRACT

**Purpose:** Physical activity (PA) has the potential to slow the progression of dementia patients' cognitive and physical decline. A better understanding of the factors that facilitate or hamper dementia patients' PA participation will increase the success rate of implementing PA in dementia patients' daily care. We systematically screened the barriers, motivators, and facilitators of PA participation in dementia patients, complementing previous analyses of quantitative correlates of PA in community-dwelling dementia patients.

**Methods:** Systematic searches yielded 78 potential studies of which seven met the eligibility criteria including 39 dementia patients and 36 caregivers (33 spouses and three daughters).

**Results:** We identified 35 barriers, 26 motivators, and 21 facilitators related to PA. We reduced these factors to six themes within the social-ecological model. Prominent barriers to PA were physical and mental limitations and difficulties with guidance and organization of PA by caregivers. Motivators included the motivation to maintain physical and mental health and participate in preferred PA options. Facilitators included strategies to avoid health problems, providing support and guidance for PA, and access to convenient and personalized PA options.

**Conclusions:** The emerging picture suggests that dementia patients' PA participation will increase if service providers become familiar with the health benefits of PA, the characteristics of PA programs, methods of delivery, and the concepts of how such programs can be personalized to and synchronized with patients' individual needs.

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## 1. Introduction

With the worldwide aging of the population, the number of dementia patients is expected to increase steeply from the current 35.6 million to 115.4 million in 2050 (Ferri et al., 2005; Prince et al., 2013). Dementia is a disabling, expensive, and burdensome health condition characterized by reductions in executive function, memory, and attention (Barberger-Gateau, Fabrigoule, Amieva, Helmer, & Dartigues, 2002; Burns & Iliffe, 2009). In addition, dementia is associated with limitations in physical performance, including a compromised endurance capacity and decline in muscle strength, balance, and mobility (Burton, Strauss, Bunce, Hunter, & Hultsch, 2009; Makizako et al., 2011). Predictably, there is a massive public health effort to identify treatments that can delay disease onset and slow its progression (Takeda, Tanaka, Okochi, & Kazui, 2012).

Like healthy old adults, dementia patients also benefit from being physically active. Although dementia is a progressive neurodegenerative disease, there is some evidence that regular PA can improve dementia patients' physical and cognitive function (Bossers et al., 2015; Heyn, Abreu, & Ottenbacher, 2004), depression (Knöchel et al., 2012), rest-activity rhythm (Hooghiemstra, Eggermont, Scheltens, van der Flier, & Scherder, 2015), quality of life (Knöchel et al., 2012), and activities of daily living (ADL's) (Blankevoort et al., 2010; Forbes et al., 2015; Lucia & Ruiz, 2011). Complementing the health benefits of PA, there is growing evidence that physical inactivity substantially increases the risk for cardiovascular diseases, metabolic aberrations, and other adverse health conditions associated with an early onset of disease (Hortobágyi, 2014; Woodcock, Franco, Orsini, & Roberts, 2011), accelerating the path to dementia. Despite the health benefits of PA and the detrimental effects of physical inactivity, dementia patients' PA levels are low and decrease even more precipitously compared to age-similar, dementia-free old adults (Burns, Mayo, Anderson, Smith, & Donnelly, 2008; Paavilainen et al., 2005; Van Alphen et al., 2016).

In order to increase dementia patients' PA levels, there is a need to better understand the factors that affect PA behavior in this population. Specifically, identifying the barriers, motivators, and facilitators of PA may increase the success rate of PA implementation geared for dementia patients' care. Many factors affect PA participation, making it a dynamic and complex process (McLeroy, Bibeau, Steckler, & Glanz, 1988; Sallis et al., 2006). Active and inactive community-dwelling older adults for instance shared some barriers to regular PA participation, but only physically active older adults developed strategies to overcome these barriers (Costello, Kafchinski, Vrazel, & Sullivan, 2011). In addition, a recent review in the dementia-free oldest-old (80+ year) showed that promoting PA in these old adults requires caregivers to explicitly explain the health benefits of PA, dissolve PA-associated fear, prioritize individual preferences towards PA, provide social support, and minimize or eliminate environmental constraints that may hinder the oldest-old from becoming physically active (Baert, Gorus, Mets, Geerts, & Bautmans, 2011).

Due to dementia patients' low functional and cognitive capacity, it is conceivable that the barriers, motivators, and

facilitators of PA are different for old adults with dementia compared with dementia-free old adults. In addition, it is possible that the support caregivers provide for dementia patients modifies the structure of variables that predict whether or not a patient with dementia remains or becomes physically active (Stubbs et al., 2014). In particular, we conjecture that caregivers and PA policies have a substantially greater influence on the PA participation of dementia patients because dementia patients more so than age-matched dementia-free old adults depend on care and support.

However, dementia patients' caregivers can draw on limited knowledge concerning the factors that influence dementia patients' PA participation, which is reported as challenging and distressing (Lord, Livingston, & Cooper, 2015). There is only one recent review that provided an elegant analysis of the quantitative correlates of PA participation in community-dwelling adults with dementia (Stubbs et al., 2014). Unexpectedly, this review found that increasing age and lower global cognition were not consistently associated with PA participation (Stubbs et al., 2014) while several PA-related factors (e.g., health-related quality of life, medication use, ADL level, number of waking hours) revealed an unfavorable trend with advancing age and dementia progression (Feldman, Van Baelen, Kavanagh, & Torfs, 2005; Hooghiemstra et al., 2015). However, effects of PA-related factors could be masked by other factors influencing PA participation. Therefore, factors that are, for instance, negatively associated with PA are not necessarily acting as PA barriers. Stubbs et al. (2014) identified several important factors linked to dementia patients' PA participation but left nonetheless undefined if these and perhaps other factors could act at the same time as barriers, motivators, or facilitators of PA. In addition, the list of factors may be incomplete because Stubbs et al. (2014) did not identify any correlates on the community level (physical environment and policy factors). In addition, even though caregivers' and dementia patients' experiences, perceptions, and knowledge regarding the barriers, motivators, and facilitators of PA provide perhaps the most powerful insights into dementia patients' PA behavior, previous reviews in dementia patients did not incorporate qualitative studies in the analysis (Stubbs et al., 2014).

A better understanding of the factors that facilitate or hamper dementia patients' PA participation may increase the success rate of PA implementation geared for the care of dementia patients. Thus, the aim of this review was to identify the barriers, facilitators and motivators related to the PA participation of institutionalized as well as community-dwelling dementia patients. We classified these factors within the theoretical framework of the social-ecological model (McLeroy et al., 1988). This model can successfully classify potential factors associated with PA participation in old adults with and without dementia (Baert et al., 2011; McLeroy et al., 1988; Sallis et al., 2006; Stubbs et al., 2014). The social-ecological model posits that many factors at multiple levels could affect PA participation, including intrapersonal factors (e.g., socio-demographic or psychological), interpersonal factors (e.g., social support), and community factors (e.g., rules and access to facilities) (McLeroy et al., 1988; Sallis et al., 2006). We prefer this framework to other models (e.g., stages of change model, self-efficacy model) that

assign less weight to environmental factors, factors we consider critical in dementia patients' PA participation.

## 2. Methods

### 2.1. Literature search

We searched PubMed (using MeSH terms), Web of Science, and PsycINFO with no restrictions on study type and date of publication for papers published in English or Dutch using the terms 'dementia' or 'cognitive impairment' or 'nursing homes' or 'geriatric care' combined with 'physical activity' or 'exercise' or 'motor activity' or 'inactivity' or 'sedentary' and 'barriers' or 'motivators' or 'facilitators' or 'implementation'. We also searched for the terms 'experiences' or 'perspectives' or 'factors' combined with terms related to PA and dementia. In addition, we analysed the references listed in the bibliography of the included papers.

### 2.2. Inclusion and exclusion criteria

We included studies that reported facilitators, barriers or motivators of PA in institutionalized and community-dwelling dementia patients over age 65 (at least mean age of 65). We included factors that motivate dementia patients to take part in PA (motivators), factors that limit dementia patients PA behavior (barriers), and factors that facilitate dementia patients' PA participation (facilitators). Studies were included if the dementia diagnosis was confirmed by medical specialists, the DSM-IV or NINCDS-ADRDA criteria (DSM-IV; APA, 1994; McKhann et al., 1984). We did not restrict for specific outcome measures of PA. However, we excluded studies in which PA was only a part of multi-modal interventions, health or lifestyle programs, or leisure activities. In addition, we excluded conference abstracts, empirical evaluation studies, and studies in which (the results for) dementia patients could not specifically ascertained.

Two of the authors independently screened studies based on title and abstract (agreement 96.0%). Disagreements were resolved based on a full-text analysis. Fig. 1 shows the flow chart of the study selection process.

### 2.3. Data extraction

Studies were coded for the following variables: participant type (dementia patient, caregiver and relative), gender, age, community-dwelling or institutionalized, country, and diagnosis. Next, barriers, motivators, and facilitators of PA were extracted and categorized into intrapersonal factors (e.g., socio-demographic or psychological), interpersonal factors (e.g., social support), and community factors (e.g., rules and access to facilities) based on the social-ecological model (McLeroy et al., 1988). For clarification, the intrapersonal factors, interpersonal factors, and community factors were sort into thematically related factors and common themes were identified.

### 2.4. Quality assessment

We assessed study quality using the methodology checklist for qualitative studies provided by the National Institute for Health and Clinical Excellence (NICE) (NICE, 2009). This checklist is based on broadly accepted principles that characterise qualitative research and that may affect its validity. Section 1 of this checklist deals with the underlying theory and principle applied to the

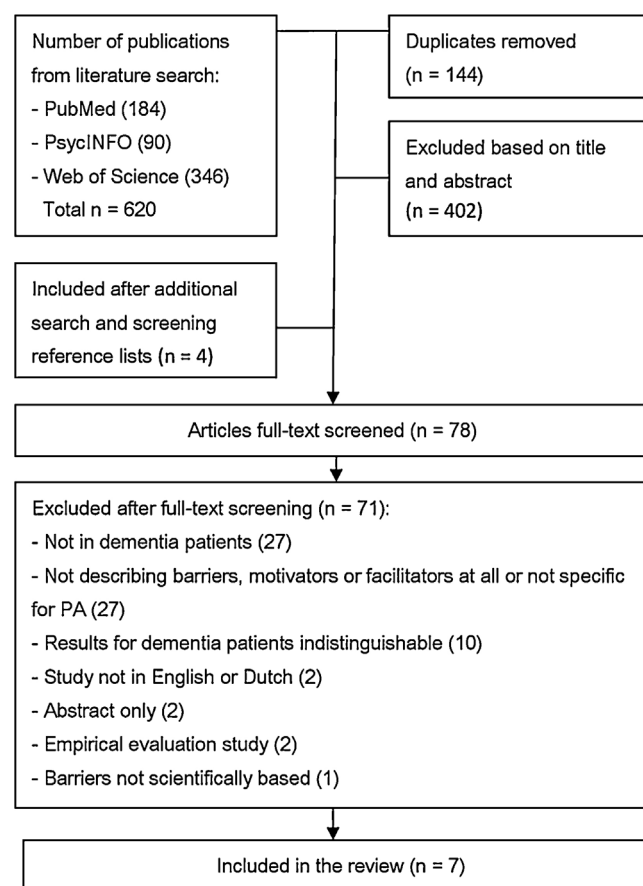


Fig. 1. Flowchart of literature search and study selection. This figure summarizes the study selection process.

research. Section 2 considers the robustness of the research design. Section 3 analysed the methods of data collection. Section 4 is about the validity and for example analysed the researcher's role in the research, the context in which the research was conducted, and the reliability of the actual data. Section 5 is about the data analysis, for example how clearly the data analysis was reported and whether this was approached systematically. The final section; section 6 involves ethical considerations. We refer to NICE (2009) for further details. For studies with a mixed design, only the quality of the qualitative study element was assessed. The quality of studies with a quantitative design was assessed using the 'Quality Assessment Tool for Quantitative Studies', developed by the Effective Public Health Practice Project (EPHPP) (EPHPP, 1998). The purpose of this quality assessment tool is to make judgements about the extent that bias may be present due to under-reporting or lack of clarity in the study. The components that were assessed were: A. Selection bias, B. Study design, C. Confounders, D. Blinding, E. Data collection methods, and F. Withdrawals and drop-outs. For more details we refer to EPHPP (1998).

## 3. Results

### 3.1. Study characteristics

The search yielded 620 studies from which we identified 476 unique studies (last search performed on March 30, 2015).

Following a full-text analysis of 78 papers, we identified seven studies for inclusion in the following study categories:

- (1) Two studies that primarily identified facilitators, motivators or barriers of PA (Malthouse & Fox, 2014; Suttanon, Hill, Said, Byrne, & Dodd, 2012).
- (2) Three studies that explored the relationship between potential barriers, motivators or facilitators and PA (Cedervall & Åberg, 2010; Cedervall, Torres, & Åberg, 2014; Dal Bello-Haas, O'Connell, Morgan, & Crossley, 2014).
- (3) Two studies that identified facilitators, motivators or barriers of PA as additional or secondary outcomes (Yu & Kolanowski, 2009; Yu et al., 2011).

Table 1 summarizes the study design, participant characteristics, and type of exercise/PA used in the different studies. These participant and study characteristics and also the quality of the included studies will be considered below. Table 2 shows the facilitators, motivators, and barriers related to the PA participation of dementia patients. Thirty-five barriers, 26 motivators, and 21 facilitators related to PA were found and reduced to six themes within the social-ecological model (Table 2).

### 3.2. Quality of the studies

Table 3 describes the quality assessment of the study using a quantitative design. The quality of this study was low, as from nine

potential participants only two participants were enrolled in the study at the end (Yu & Kolanowski, 2009). In addition, the data collection regarding the barriers and facilitators in this study was unclear (Yu & Kolanowski, 2009). The theoretical approach, study design and data collection of the six studies using a qualitative design were good (see 1.1–3.1 in Table 4). In general, the validity and data analysis of these studies were sufficiently high (see sections 4 and 5 in Table 4). However, a few studies were limited on elements of the validity and analysis section (sections 4 and 5) of the quality checklist.

#### 3.2.1. Section 4, validity

Two studies reported participant characteristics inadequately as they did not report patients' gender (Dal Bello-Haas et al., 2014; Malthouse & Fox, 2014). In one case, the data collection regarding PA barriers, motivators, and facilitators was limited, as the authors asked only two open-ended questions (Yu et al., 2011). The data collection could possibly have been 'richer' if the data had been collected by the use of a theoretical framework. Another study used semi-structured in-depth interviews to establish a conversational style and to spontaneously question participants (Suttanon et al., 2012), a method that is not free of response-bias. In addition, the caregiver's presence during these interviews could have influenced patient's answers (Suttanon et al., 2012).

**Table 1**  
Characteristics overview of included articles.

Reference	Study design	Participants	Diagnosis	Age (Mean $\pm$ SD) of patients	% Male	Living situation	PA definition	Country
Cedervall et al. (2014)	Qualitative interviews	14 patients 14 partners	14 mild AD MMSE 24.5 $\pm$ 2.9 (range 21–30) NINCDS-ADRDA criteria of probable AD	69.9 $\pm$ 7.1 y	75	Community-dwelling	Outdoor walks, cycling, household activities	Sweden
Cedervall and Åberg (2010)	Qualitative case study design	2 patients 2 spouses	2 mild AD MMSE 21.5 $\pm$ 0.7 Clinical diagnosis by memory clinic	68.5 $\pm$ 7.8 y	100	Community-dwelling	Outdoor walks	Sweden
Dal Bello-Haas et al. (2014)	Qualitative survey and interviews and quantitative NCT	2 patients 2 caregiver-dyads (other participants not relevant)	1 AD, 1 FTD Clinical diagnosis by Rural and Remote Memory Clinic (RRMC)	NA	NA	Community-dwelling	Telehealth-exercise; Aerobic exercise using an upper extremity cycle ergometer	Canada
Malthouse and Fox (2014)	Qualitative interviews	5 patients 5 spouses	5 AD MMSE range 18–21 Clinical diagnosis by memory clinic	64–84 y	NA	Community-dwelling in domiciliary setting	PA as defined by Department of Health UK (e.g., walking, cycling, active recreation, sport)	England
Suttanon et al. (2012)	Qualitative interviews	10 patients 9 caregivers (6/9 spouse)	10 mild to moderate AD MMSE 23.4 (range 16–28) Diagnosis by medical specialist or memory clinic assessment	81.6 $\pm$ 5.2 y	30	Community-dwelling	Home-based balance exercise	Australia
Yu and Kolanowski (2009)	Quantitative NCT and qualitative reports	2 patients	2 AD MMSE 21 $\pm$ 5.7 (baseline) Diagnosis from medical clearance	80.5 y	50	Community-dwelling in own home and retirement community	Aerobic exercise; cycling	USA
Yu et al. (2011)	Quantitative NCT and qualitative interviews	4 patients 4 spouses	4 moderate-to-severe AD MMSE 7.8 $\pm$ 4.3 (range 2–12) AD diagnosis from medical clearance	70.8 $\pm$ 8.8 y	100	Community-dwelling	Aerobic exercise; recumbent stationary cycling	USA

**Table 2**

Themes of factors influencing physical activity behavior in dementia patients within the social-ecological model.

Barriers	Motivators	Facilitators
Intrapersonal level		
Physical or Mental Health		
Physical Health: <ul style="list-style-type: none"> <li>• Health conditions (pain or risk of falling) (Malthouse and Fox, 2014)</li> <li>• Pre-existing/acute health conditions (Suttanon et al., 2012)</li> <li>• Impaired body function (Cedervall et al., 2014)</li> <li>• Decreased energy level (Cedervall et al., 2014)</li> <li>• Tiredness (Cedervall &amp; Åberg, 2010)</li> </ul> Mental Health: <ul style="list-style-type: none"> <li>• Impaired orientation ability (Cedervall et al., 2014)</li> <li>• Problems with attention and memory (Yu &amp; Kolanowski, 2009)</li> <li>• Lack of insight and trust (Yu &amp; Kolanowski, 2009)</li> <li>• Emotional barriers (anxiety and/or feelings of unease) (Cedervall et al., 2014)</li> <li>• Negative feelings (starting to feel down) (Malthouse &amp; Fox, 2014)</li> <li>• Peculiar behavior (Cedervall &amp; Åberg, 2010)</li> <li>• Loss of motivation and resources (Yu &amp; Kolanowski, 2009)</li> </ul>	<ul style="list-style-type: none"> <li>• Possible benefits (improve memory, physical benefits) (Suttanon et al., 2012)</li> <li>• Perceived benefits (Suttanon et al., 2012)</li> <li>• Beneficial effects (Dal Bello-Haas et al., 2014; Yu et al., 2011)</li> <li>• PA routines are meaningful (feelings of well-being through PA, described PA as relaxing and refreshing) (Cedervall et al., 2014)</li> <li>• Concern about well-being (Cedervall &amp; Åberg, 2010)</li> <li>• Awareness of the diagnosis (Yu et al., 2011)</li> <li>• Positive feelings associated with being active (Malthouse &amp; Fox, 2014)</li> <li>• Appreciation of the benefits (healthy body, healthy mind) (Malthouse &amp; Fox, 2014)</li> </ul>	<ul style="list-style-type: none"> <li>• Mental strategies (e.g., suppressed difficulties caused by the disease in order to feel good) (Cedervall &amp; Åberg, 2010); focused on what worked well today (Cedervall et al., 2014)</li> </ul>
Individual Preferences		
<ul style="list-style-type: none"> <li>• Dislike of structured exercise (Suttanon et al., 2012)</li> </ul>	<ul style="list-style-type: none"> <li>• Enjoyment (Yu et al., 2011)</li> <li>• Past activity enjoyment (Malthouse &amp; Fox, 2014)</li> <li>• Enjoyment experienced from nature (Cedervall &amp; Åberg, 2010)</li> <li>• Enjoyable experience (Dal Bello-Haas et al., 2014)</li> <li>• Participants' sense of commitment (Suttanon et al., 2012)</li> <li>• Positive attitude and prior exercise experience (Suttanon et al., 2012)</li> <li>• Positive attitudes towards PA (Cedervall &amp; Åberg, 2010)</li> <li>• Assist with research (value of research) (Suttanon et al., 2012)</li> <li>• Minimize caregiver burden (Suttanon et al., 2012)</li> <li>• Desire and need to go outdoors (Cedervall et al., 2014)</li> <li>• Keeping the body as good as possible (Yu et al., 2011)</li> <li>• Body movement was reported as motivation for regular walks (not further specified in the article) (Cedervall &amp; Åberg, 2010)</li> <li>• Strong wish to stay physically active and keep fit (Cedervall et al., 2014)</li> <li>• Compare activity routines and capacity with others (sense of well-being improved when they compared their abilities and PA levels to the abilities and activity levels of others) (Cedervall et al., 2014)</li> </ul>	
Interpersonal Level		
Support		
<ul style="list-style-type: none"> <li>• Feeling forced (Malthouse &amp; Fox, 2014)</li> <li>• Loss of freedom (Malthouse &amp; Fox, 2014)</li> <li>• Perceived disruptive behaviors by family members (Yu &amp; Kolanowski, 2009)</li> <li>• Decreased health and energy of caregivers to be active with their dementia partner (Malthouse &amp; Fox, 2014)</li> <li>• Caregivers doubts about potential benefits (Yu &amp; Kolanowski, 2009)</li> <li>• Burden on caregivers (Yu &amp; Kolanowski, 2009)</li> <li>• Caregivers' factors (caregiver's health or commitment) (Suttanon et al., 2012)</li> <li>• Concerns regarding safety ('old adults with AD might not be able to reliably report adverse reactions to exercise') (Yu &amp; Kolanowski, 2009)</li> </ul>	<ul style="list-style-type: none"> <li>• Relationship with dog (Cedervall &amp; Åberg, 2010)</li> </ul>	<ul style="list-style-type: none"> <li>• Community walking groups (Malthouse &amp; Fox, 2014)</li> <li>• Volunteer walking guides (Malthouse &amp; Fox, 2014)</li> <li>• Caregivers' support (Suttanon et al., 2012)</li> <li>• Spouse support (Yu et al., 2011)</li> <li>• Physiotherapist (Suttanon et al., 2012)</li> <li>• Dog walking (Malthouse &amp; Fox, 2014)</li> <li>• Attitude of the spouse towards PA (it would be good for him) (Yu et al., 2011)</li> <li>• Wanted to help to get the program going (spouse) (Yu et al., 2011)</li> <li>• Positive experience of the spouse (Yu et al., 2011)</li> <li>• Advice from health professionals (Suttanon et al., 2012)</li> <li>• Practical strategies (e.g., avoidance of demanding activities and reliance on a partner) (Cedervall et al., 2014); using cell phone during daily walks (Cedervall &amp; Åberg, 2010)</li> </ul>

**Table 2** (Continued)

Barriers	Motivators	Facilitators
Social Identification		
<ul style="list-style-type: none"> <li>Lack of understanding by other people (Malthouse &amp; Fox, 2014)</li> </ul>	<ul style="list-style-type: none"> <li>Being with people in the same situation (Dal Bello-Haas et al., 2014)</li> <li>Being with other people who are also just like me (Yu et al., 2011)</li> <li>Other people with whom they could identify (Malthouse &amp; Fox, 2014)</li> </ul>	
Community level		
Structural and Organizational Factors		
<ul style="list-style-type: none"> <li>Time consuming (Yu et al., 2011)</li> <li>Get him ready for exercise sessions (Yu et al., 2011)</li> <li>Time commitment (Yu et al., 2011)</li> <li>Transportation (Yu et al., 2011)</li> <li>Lack of exercise programs (Yu &amp; Kolanowski, 2009)</li> <li>Obtaining collaboration from care practitioner for medical clearance (Yu &amp; Kolanowski, 2009)</li> <li>Closure of leisure centers over bank holidays (Malthouse &amp; Fox, 2014)</li> <li>Having only one specific exercise mode (cycle ergometer) was somewhat limiting (Dal Bello-Haas et al., 2014)</li> </ul>		<ul style="list-style-type: none"> <li>Norms and public health recommendations (Cedervall et al., 2014)</li> <li>Routine (Cedervall et al., 2014; Malthouse &amp; Fox, 2014)</li> <li>Slowly introduction of new activities (Malthouse &amp; Fox, 2014)</li> <li>Program characteristics (Suttanon et al., 2012)</li> <li>Recumbent stationary cycling (Yu &amp; Kolanowski, 2009)</li> <li>Telehealth is easy to use (Dal Bello-Haas et al., 2014)</li> <li>Exercise recording sheet (Suttanon et al., 2012)</li> <li>Person leading the activity (Malthouse &amp; Fox, 2014)</li> </ul>
Physical Environment		
<ul style="list-style-type: none"> <li>Environmental barriers (Cedervall et al., 2014)</li> <li>Difficulties finding the way (Cedervall &amp; Åberg, 2010)</li> <li>Being away from home (Suttanon et al., 2012)</li> <li>Dedicated space and storage issues (Dal Bello-Haas et al., 2014)</li> <li>Bad weather (Malthouse &amp; Fox, 2014; Suttanon et al., 2012)</li> </ul>		<ul style="list-style-type: none"> <li>Avoidance strategies (walking in well-known areas) (Cedervall et al., 2014)</li> </ul>

3.2.2. Section 5, analysis

One study reported interview fragments but it remained unclear from these extracts how PA-related barriers, motivators, and facilitators were determined (Dal Bello-Haas et al., 2014). Another study used a thematic analysis for the identification of barriers, motivators, and facilitators related to PA (Malthouse & Fox, 2014). However, the authors themselves admitted in their discussion that the line of questioning might have limited the depth of the analysis and the scope of the conclusions (Malthouse & Fox, 2014).

3.3. Participants

The seven studies included a total of 75 subjects (Table 1). The cohort consisted of 39 community-dwelling dementia patients, and 36 caregivers (33 spouses and three daughters). Ninety-seven

percent of the participants were diagnosed with Alzheimer's disease (AD) and all participants were community-dwelling old adults who lived in their own home (Cedervall & Åberg, 2010; Cedervall et al., 2014; Dal Bello-Haas et al., 2014; Malthouse & Fox, 2014; Suttanon et al., 2012; Yu & Kolanowski, 2009; Yu et al., 2011) such as a domiciliary setting (not a residential or nursing home) with care services provided in patients' own home (Malthouse & Fox, 2014).

3.4. Type of exercise/physical activity

The majority of the studies defined PA as aerobic exercise, consisting of cycling or walking activity. One study defined PA as an umbrella term and included any activities: walking or cycling, work-related activity, active recreation, dancing, gardening, playing active games, and organized and competitive sport (Malthouse & Fox, 2014), while another study reported outdoor walks, cycling, and household activities as PA (Cedervall et al., 2014). Five studies defined PA in the form of the content of an intervention: aerobic exercise (Yu & Kolanowski, 2009; Yu et al., 2011), telehealth-delivered exercise, comprising aerobic exercise using an upper extremity cycle ergometer (Dal Bello-Haas et al., 2014), and regular walks (Cedervall & Åberg, 2010). In addition, one study defined PA as home-based balance exercise instead of aerobic exercise (Suttanon et al., 2012).

**Table 3**  
Quality assessment of the quantitative study.

Reference	A	B	C	D	E	F
Yu and Kolanowski (2009)	+/-	-	-	-	+/-	-

+ = Strong, +/- = moderate, - = weak; A = Selection bias; B = Study design; C = Confounder; D = Blinding; E = Data collection methods; F = Withdrawals and drop-outs.

**Table 4**  
Quality assessment of the qualitative studies.

Reference	Theoretical approach		Study design	Data collection	Validity			Analysis					Ethics		
	1.1	1.2			2.1	3.1	4.1	4.2	4.3	5.1	5.2	5.3		5.4	5.5
Cedervall et al. (2014)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Cedervall and Åberg (2010)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Dal Bello-Haas et al. (2014)	+	+	+	+	+	–	+	?	?	+	+	+	+	+	+
Malthouse and Fox (2014)	+	+	+	+	+	?	+	+	?	+	+	+	?	+	+
Suttanon et al. (2012)	+	+	+	+	+	?	+	+	+	+	+	+	+	+	+
Yu et al. (2011)	+	+	+	+	+	+	?	+	+	+	+	+	+	+	+

+ = yes/good, – = no/not good, ? = not sure/dubious; 1.1 = Is a qualitative approach appropriate?; 1.2 = Is the study clear in what it seeks to do?; 2.1 = How defensible/rigorous is the research design/methodology; 3.1 = How well was the data collection carried out?; 4.1 = Is the role of the researcher clearly described?; 4.2 = Is the context clearly described; 4.3 = Were the methods reliable?; 5.1 = Is the data analysis sufficiently rigorous?; 5.2 = Are the data 'rich'?; 5.3 = Is the analysis reliable?; 5.4 = Are the findings convincing?; 5.5 = Are the findings relevant to the aims of the study?; 5.6 = Are the conclusions adequate?; 6.1 = How clear and coherent is the reporting of ethical considerations?

## 4. Discussion

### 4.1. Findings

We identified 35 barriers, 26 motivators, and 21 facilitators of PA in dementia patients. These factors appeared across all three levels of the social-ecological model. We discuss the barriers to dementia patients' PA participation at each level of the social-ecological model together with ways to overcome them using motivators and facilitators.

### 4.2. Intrapersonal level

Our review identified several physical health-related barriers to dementia patients' PA participation, such as health conditions, impaired bodily function, low energy, and tiredness, which is in agreement with a previous review that showed several health-related factors to be negatively associated with dementia patients' PA participation (Stubbs et al., 2014). In contrast to the review of Stubbs et al. (2014) who found dementia patients' global cognition not affecting their PA participation, we found that problems with attention and memory did appear as a barrier to these patients' PA participation. In addition, we identified several mental health barriers to PA, such as a lack of insight and trust, emotional barriers, negative feelings, and peculiar behavior. Because dementia is characterized by reductions in executive function, memory, and attention (Barberger-Gateau et al., 2002; Burns & Iliffe, 2009) it is not surprising that these mental health barriers are found for dementia patients but not for the dementia-free oldest-old (Baert et al., 2011). Concerning the discrepancy regarding global cognition between current review and the review of Stubbs et al. (2014), Stubbs et al. (2014) already suggested that this could be possibly explained by caregivers' compensation with additional support to engage dementia patients to take part in PA. In fact, dementia patients depend to a large extent of support to become physically active. Not only because of their limited cognitive and physical functions, but dementia patients usually also present with a loss of initiation and motivation to start with PA through apathy, which is one of the most common neuropsychiatric symptoms across all stages of AD (David et al., 2012). However, similar to the dementia-free oldest old (Baert et al., 2011), there are also dementia patients who simply do not like exercise, which we did identify as an intrapersonal barrier to PA participation in these patients.

To overcome the intrapersonal barriers to dementia patients' PA participation it is important to make use of motivators and facilitators effectively. One strategy could be to identify the main

PA barriers and model how to remove these barriers by adding specific motivators and facilitators of PA. For instance, when physical health-related factors hamper dementia patients to take part in PA, it is important to make sure that dementia patients have access to convenient PA options with the necessary support. Support through walking groups, walking guides, support of caregivers or spouses, or the presence of a physiotherapist might be important to facilitate the PA behavior of dementia patients. In addition, specific program characteristics in terms of intensity and complexity should be well tuned. The study of Suttanon et al. (2012) gave an insight in this issue for a home-based balance exercise program by reporting that a six-month program duration and exercise session length of 15–20 min were considered suitable. However, program duration and PA intensity should usually be moderated as dementia progressed (Malthouse & Fox, 2014).

Taking the mental health barriers into consideration, it is important to avoid highly demanding activities and develop a trusting relationship among patients and PA leaders. For example, a lack of trust towards PA leaders can be addressed by an incremental introduction of PA into patients' lives (Malthouse & Fox, 2014), gradually allowing patients to build trust towards the companions and staff who administering the PA program. Also, several studies noted the importance of routine for sustaining some levels of PA in dementia patients (Cedervall et al., 2014; Malthouse & Fox, 2014). In addition, current review identified strategies to handle barriers to PA. For instance, Cedervall and Åberg (2010) described that patients could use a cell phone to feel safe and keep in touch with their partner during daily walks. However, according to a previous study it is suggested that only active patients develop strategies to overcome the barriers to PA (Costello et al., 2011). It seems that inactive vs. active older adults have different priorities for time use and chose instead to engage in other activities than PA (Costello et al., 2011). In addition, inactive older adults demonstrated concerns about 'slowing others' (Costello et al., 2011). These findings illustrate the need of convenient and personalized PA options.

Moreover, it is suggested that PA/exercise interventions improve dementia patients' cognitive and physical function (Bossers et al., 2015; Heyn et al., 2004). However, it is unclear if such effects can lastingly increase spontaneous PA participation because such patients spend most of the day in a sedentary state (Van Alphen et al., 2016). Perhaps it is possible that the physiological and cognitive benefits, i.e., intrapersonal motivators of PA could lastingly increase these patients' spontaneous PA levels through improved self-efficacy (Olsen, Telenius, Engedal, & Bergland, 2015). In particular, if patients dislike exercise it could



be rather important to use research evidence about the benefits of PA to educate and encourage patients to participate in PA.

#### 4.3. Interpersonal level

At the interpersonal level, almost all barriers to PA are related to dependency on other people as described in each of the two interpersonal themes (support, social identification). In the dementia-free oldest-old, the absence of an exercise companion or lack of social support appeared as barriers to PA (Baert et al., 2011) but the low functional, cognitive, and mental capacity of dementia patients probably all contribute to a 'feeling of not being understood', a 'perceived loss of personal freedom' and a 'feeling of being forced' appearing as unique interpersonal barriers to the PA of dementia patients. These observations are in line with the review of Stubbs et al. (2014) reporting that autonomic problems negatively associate with PA, while higher levels of social functioning positively associate with dementia patients' PA participation. Current review also identified that caregivers' health and commitment and their concerns and beliefs regarding PA could hamper dementia patients' PA participation. We emphasize that increasing dementia patients' PA participation creates time pressure and added burdens to caregivers. However, on the other hand, increasing dementia patients' PA participation will ultimately reduce time pressure on a caregiver that could in turn positively affect their own health (Lowery et al., 2014).

To overcome the interpersonal barriers to dementia patients' PA participation, our interpretation is that there is an urgent need to identify methods that internally motivate and support dementia patients to become physically active rather than to decide for and/or force dementia patients externally to engage in a PA program. Any effort to modify dementia patients' attitude toward PA must incorporate a patient-specific element. Important motivations for PA could be for example the promotion of going outdoors with the enjoyment of experiencing nature or the performance of activities that patients had enjoyed all their lives (Cedervall & Åberg, 2010; Malthouse & Fox, 2014). We also notice that 'other people who are also just like me' and 'being with people in the same situation' represented statements, which were unique PA motivators for dementia patients. Similar to the dementia-free oldest old (Baert et al., 2011) an exercise companion is important to facilitate patients' PA participation. Offering exercises in small groups could positively affect dementia patients' attitude to PA through social cohesion further intensified by personal connections arising between individual patients. In addition, well-trained and experienced care staff or relatives are important to deal with disease-related behavior and to overcome the doubts about potential benefits. We suggest that dementia patients' PA participation will increase if caregivers become familiar with and understand the health benefits of PA, because emphasizing the health benefits might be a major element in the PA promotion of patients with dementia.

#### 4.4. Community level

While a previous review did not find any factors within the community level (Stubbs et al., 2014), we did identify several such factors affecting dementia patients' PA participation. Similar to the dementia-free oldest old (Baert et al., 2011), barriers included working out the transportation and the time commitment, a lack of dedicated space, bad weather, and lack of specifically designed exercise programs. Moreover, environmental barriers such as difficulties in finding the way and being away from home were reported as unique barriers to dementia patients' PA

participation. Another barrier in implementing a PA program in the daily life of dementia patients was obtaining collaboration from the primary care practitioner for medical clearance.

As old adults with dementia require intensive care, the large number of community factors as PA barriers was not unexpected. However, although it is suggested that caregivers are the primary resource for activating dementia patients, it may be unrealistic to seek such organization from caregivers due to already highly demanding and stressful assignment to care for dementia patients (Bonner & Cousins, 1996). Providing PA incentives and programs for dementia patients may require communities to come up with creative solutions for PA delivery: modifications in the micro and macro environment in which a more active lifestyle is implemented, through technology (Lancioni et al., 2015), and PA programs offered at home (Suttanon et al., 2012). In addition, because the weather could also act as a barrier to PA, it may be important to provide in- and outdoor facilities for PA. Moreover, to make sure that permission for PA participation will be provided by care staff, Yu and Kolanowski (2009) already suggested that proactive and respectful communication, networking, and collaboration between caregivers and PA providers are important in the facilitation of PA to patients. Current review also found that norms and public health recommendations as well as advice from health professionals are important to facilitate dementia patients' PA participation. However, the current PA recommendations from government guidelines, health authorities, and directives issued by the World Health Organization are not disease-specific (American College of Sports Medicine, Chodzko-Zajko, Proctor, & Fiatarone Singh, 2009; WHO, 2010). To promote dementia patients' PA participation with the most substantial favorable physiological changes and health benefits, disease-specific PA recommendations should be established. In addition, caregivers should receive information concerning health literacy knowledge, including the favorable effects of PA and the unfavorable effects of sedentariness on motor and cognitive function.

#### 4.5. Limitations

We identified a large number but most likely not all of barriers, motivators, and facilitators related to dementia patients' PA participation. Although our original intent was to identify PA barriers, motivators, and facilitators in patients who live in the community and also who reside in institutions, such stratification was not possible because we identified no studies that explicitly examined this issue in institutionalized dementia patients. We also assigned no weightings to the barriers, motivators, and facilitators, making it impossible to model how removing a barrier or adding a facilitator would affect dementia patients' PA behavior. We recommend future studies to model how removing a barrier or adding a facilitator would affect dementia patients' PA behavior. In addition, the low number of studies presumably limit the scope of our conclusions: we had to exclude studies because the PA-related factors were not systematically inventoried causing a lack of study details (Logsdon, McCurry, & Teri, 2005; Neville, Clifton, Henwood, Beattie, & McKenzie, 2013) and because participants and/or results were not stratified by 'non-dementia vs. dementia patient' (e.g., Benjamin, Edwards, & Caswell, 2009; Brach, Nieder, Nieder, & Mechling, 2009; Chong et al., 2014; Kalinowski et al., 2012) or PA vs. other activities (e.g., Söderhamn, Landmark, Eriksen, & Söderhamn, 2013; Söderhamn, Aasgaard, & Landmark, 2014; Tak, Kedia, Tongumpun, & Hong, 2015). Such shortcomings most likely affected the inclusion of institutionalized patients as well as our analyses concerning community-dwelling dementia patients. However, because a large number of factors overlapped between studies, we suggest

that the limited quality of some study elements had a marginal effect on our conclusions. However, more well-designed studies are needed to identify the full scope of facilitators, motivators, and barriers related to PA in dementia patients.

The low number of studies also prevented us from categorizing patients by diagnosis or PA type. However, this limitation does not affect our conclusions because 97% of the patients had a diagnosis of AD and aerobic exercise was the preferred choice of PA. While Yu et al. (2011) reported an MMSE score of 7.8, far lower than the rest of studies, disease severity across the studies seemed homogenous with little effect on our conclusions. However, caution is needed regarding the generalizability of our study. We recommend future research on the PA barriers, motivators, and facilitators in patients with AD as well as in patients with other dementia diagnoses.

Admittedly, the diagnosis criteria of dementia varied between studies due to the diversity between screening tools. Our analyses are weakened by ‘probable diagnoses’ of dementia (McKhann et al., 1984) instead of using a validated and more comprehensive diagnosis tool only (Diagnostic and Statistical Manual of Mental Disorders; DSM-IV; APA, 1994). Regardless of the ultimate diagnosis accuracy, all dementia patients could potentially benefit from becoming physically more active and spending less time in a sedentary state.

## 5. Conclusion

Based on the PA barriers, motivators, and facilitators of dementia patients identified by this review, we suggest that dementia patients’ PA participation will increase if service providers become familiar with the health benefits of PA, the characteristics of PA programs, methods of delivery, and the concepts of how such programs can be personalized to and synchronized with patients’ individual needs. We recommend that health care professionals consider PA barriers, motivators, and facilitators identified by this review in the implementation of PA programs for dementia patients living in the community. As there are no studies explicitly describing barriers, motivators, and facilitators for PA specific for institutionalized dementia patients, we recommend future studies to examine PA-related factors specifically in institutionalized dementia patients. In addition, we recommend future research on the PA barriers, motivators, and facilitators in patients with AD as well as in patients with other dementia diagnoses.

## Author contributions

Conceived and designed the study: MJGvH and HJMvA. Literature search HJMvA. Study selection: MJGvH and HJMvA. Data extraction: HJMvA. Wrote the paper: HJMvA, MJGvH, and TH.

## References

- American College of Sports Medicine, Chodzko-Zajko, W. J., Proctor, D. N., & Fatarone Singh, M. A. (2009). American College of Sports Medicine position stand. Exercise and physical activity for older adults. *Medicine & Science in Sports & Exercise*, *41*, 1510–1530.
- American Psychiatric Association (1994). *Diagnostic and statistical manual of mental disorders (DSM IV)*, 4th ed. American Psychiatric Association.
- Baert, V., Gorus, E., Mets, T., Geerts, C., & Bautmans, I. (2011). Motivators and barriers for physical activity in the oldest old: a systematic review. *Ageing Research Reviews*, *10*, 464–474.
- Barberger-Gateau, P., Fabrigoule, C., Amieva, H., Helmer, C., & Dartigues, J. F. (2002). The disablement process: a conceptual framework for dementia-associated disability. *Dementia and Geriatric Cognitive Disorders*, *13*, 60–66.
- Benjamin, K., Edwards, N., & Caswell, W. (2009). Factors influencing the physical activity of older adults in long-term care: administrators’ perspectives. *Journal of Aging and Physical Activity*, *17*, 181–195.
- Blankevoort, C. G., van Heuvelen, M. J., Boersma, F., Luning, H., de Jong, J., & Scherder, E. J. (2010). Review of effects of physical activity on strength, balance, mobility and ADL performance in elderly subjects with dementia. *Dementia and Geriatric Cognitive Disorders*, *30*, 392–402.
- Bonner, A. P., & Cousins, S. O. B. (1996). Exercise and Alzheimer’s disease: benefits and barriers. *Activities, Adaptation and Aging*, *20*, 21–34.
- Bossers, W. J., van der Woude, L. H., Boersma, F., Hortobágyi, T., Scherder, E. J., & van Heuvelen, M. J. (2015). A nine-week-long aerobic and strength training program improves cognitive and motor function in patients with dementia: a randomized, controlled trial. *American Journal of Geriatric Psychiatry*, *23*, 1106–1116.
- Brach, M., Nieder, F., Nieder, U., & Mechling, H. (2009). Implementation of preventive strength training in residential geriatric care: a multi-centre study protocol with one year of interventions on multiple levels. *BMC Geriatrics*, *9*, 51.
- Burns, A., & Iliffe, S. (2009). Alzheimer’s disease. *BMJ*, *338*, b158.
- Burns, J. M., Mayo, M. S., Anderson, H. S., Smith, H. J., & Donnelly, J. E. (2008). Cardiorespiratory fitness in early-stage Alzheimer disease. *Alzheimer Disease and Associated Disorders*, *22*, 39–46.
- Burton, C. L., Strauss, E., Bunce, D., Hunter, M. A., & Hultsch, D. F. (2009). Functional abilities in older adults with mild cognitive impairment. *Gerontology*, *55*, 570–581.
- Cedervall, Y., & Åberg, A. C. (2010). Physical activity and implications on well-being in mild Alzheimer’s disease: a qualitative case study on two men with dementia and their spouses. *Physiotherapy Theory and Practice*, *26*, 226–239.
- Cedervall, Y., Torres, S., & Åberg, A. C. (2014). Maintaining well-being and selfhood through physical activity: experiences of people with mild Alzheimer’s disease. *Ageing & Mental Health* 1–10.
- Chong, T. W., Doyle, C. J., Cyarto, E. V., Cox, K. L., Ellis, K. A., Ames, D., et al. (2014). Physical activity program preferences and perspectives of older adults with and without cognitive impairment. *Asia-Pacific Psychiatry*, *6*, 179–190.
- Costello, E., Kafchinski, M., Vrazel, J., & Sullivan, P. (2011). Motivators, barriers, and beliefs regarding physical activity in an older adult population. *Journal of Geriatric Physical Therapy*, *34*, 138–147.
- Dal Bello-Haas, V. P. M., O’Connell, M. E., Morgan, D. G., & Crossley, M. (2014). Lessons learned: feasibility and acceptability of a telehealth-delivered exercise intervention for rural-dwelling individuals with dementia and their caregivers. *Rural and Remote Health*, *14*, 2715.
- David, R., Mulin, E., Friedman, L., Le Duff, F., Cygankiewicz, E., Deschaux, O., et al. (2012). Decreased daytime motor activity associated with apathy in Alzheimer disease: an actigraphic study. *American Journal of Geriatric Psychiatry*, *20*, 806–814.
- Effective Public Health Practice Project, 1998. Quality Assessment Tool For Quantitative Studies. Retrieved from <http://www.ehpp.ca/tools.html>.
- Feldman, H. H., Van Baelen, B., Kavanagh, S. M., & Torfs, K. E. (2005). Cognition, function, and caregiving time patterns in patients with mild-to-moderate Alzheimer disease: a 12-month analysis. *Alzheimer Disease and Associated Disorders*, *19*, 29–36.
- Ferri, C. P., Prince, M., Brayne, C., Brodaty, H., Fratiglioni, L., Ganguli, M., et al. (2005). Global prevalence of dementia: a delphi consensus study. *Lancet*, *366*, 2112–2117.
- Forbes, D., Forbes, S., Morgan, D. G., Markle-Reid, M., Wood, J., & Culum, I. (2015). Exercise programs for people with dementia. *Cochrane Database of Systematic Reviews*, *4*, .
- Heyn, P., Abreu, B. C., & Ottenbacher, K. J. (2004). The effects of exercise training on elderly persons with cognitive impairment and dementia: a meta-analysis. *Archives of Physical Medicine and Rehabilitation*, *85*, 1694–1704.
- Hooghiemstra, A. M., Eggermont, L. H., Scheltens, P., van der Flier, W. M., & Scherder, E. J. (2015). The rest-activity rhythm and physical activity in early-onset dementia. *Alzheimer Disease and Associated Disorders*, *29*, 45–49.
- Hortobágyi, T. (2014). The positives of physical activity and the negatives of sedentariness in successful aging. In H. Rutgers (Ed.), *The future of health and fitness. A plan for getting europe active by 2025* (pp. 54–62). Nijmegen, The Netherlands: BlackBoxPublishers.
- Kalinowski, S., Wulff, I., Kölzsch, M., Kopke, K., Kreutz, R., & Dräger, D. (2012). Physical activity in nursing homes—barriers and facilitators: a cross-sectional study. *Journal of Aging and Physical Activity*, *20*, 421–441.
- Knöchel, C., Oertel-Knöchel, V., O’Dwyer, L., Prvulovic, D., Alves, G., Kollmann, B., et al. (2012). Cognitive and behavioural effects of physical exercise in psychiatric patients. *Progress in Neurobiology*, *96*, 46–68.
- Lancioni, G. E., Singh, N. N., O’Reilly, M. F., Sigafos, J., D’Amico, F., Sasanelli, G., et al. (2015). Persons with Alzheimer’s disease engage in leisure and mild physical activity with the support of technology-aided programs. *Research in Developmental Disabilities*, *37*, 55–63.
- Logsdon, R. G., McCurry, S. M., & Teri, L. (2005). A home health care approach to exercise for persons with Alzheimer’s disease. *Care Management Journals*, *6*, 90–97.
- Lord, K., Livingston, G., & Cooper, C. (2015). A systematic review of barriers and facilitators to and interventions for proxy decision-making by family carers of people with dementia. *International Psychogeriatrics*, *27*, 1301–1312.
- Lowery, D., Cerga-Pashoja, A., Iliffe, S., Thuné-Boyle, I., Griffin, M., Lee, J., et al. (2014). The effect of exercise on behavioural and psychological symptoms of dementia: the EVIDEM-E randomised controlled clinical trial. *International Journal of Geriatric Psychiatry*, *29*, 819–827.
- Lucia, A., & Ruiz, J. R. (2011). Exercise is beneficial for patients with Alzheimer’s disease: a call for action. *British Journal of Sports Medicine*, *45*, 468–469.

- Makizako, H., Shimada, H., Doi, T., Yoshida, D., Ito, K., Kato, T., et al. (2011). The association between decline in physical functioning and atrophy of medial temporal areas in community-dwelling older adults with amnesic and nonamnesic mild cognitive impairment. *Archives of Physical Medicine and Rehabilitation*, *92*, 1992–1999.
- Malthouse, R., & Fox, F. (2014). Exploring experiences of physical activity among people with Alzheimer's disease and their spouse carers: a qualitative study. *Physiotherapy*, *100*, 169–175.
- McKhann, G., Drachman, D., Folstein, M., Katzman, R., Price, D., & Stadlan, E. M. (1984). Clinical diagnosis of Alzheimer's disease: report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. *Neurology*, *34*, 939–944.
- McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly*, *15*, 351–377.
- NICE (2009). *Methodology checklist: qualitative studies*. National Institute for Health and Clinical Excellence.
- Neville, C., Clifton, K., Henwood, T., Beattie, E., & McKenzie, M. A. (2013). Watermemories: a swimming club for adults with dementia. *Journal of Gerontological Nursing*, *39*, 21–25.
- Olsen, C. F., Telenius, E. W., Engedal, K., & Bergland, A. (2015). Increased self-efficacy: the experience of high-intensity exercise of nursing home residents with dementia—a qualitative study. *BMC Health Services Research*, *15*, 1.
- Paavilainen, P., Korhonen, I., Lotjonen, J., Cluitmans, L., Jylha, M., Sarela, A., et al. (2005). Circadian activity rhythm in demented and non-demented nursing-home residents measured by telemetric actigraphy. *Journal of Sleep Research*, *14*, 61–68.
- Prince, M., Bryce, R., Albanese, E., Wimo, A., Ribeiro, W., & Ferri, C. P. (2013). The global prevalence of dementia: a systematic review and metaanalysis. *Alzheimer's & Dementia*, *9*, 63–75 e2.
- Sallis, J. F., Certero, R. B., Adcher, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annual Review of Public Health*, *27*, 297–322.
- Söderhamn, U., Landmark, B., Eriksen, S., & Söderhamn, O. (2013). Participation in physical and social activities among home-dwelling persons with dementia—experiences of next of kin. *Psychology Research and Behavior Management*, *6*, 29.
- Söderhamn, U., Aasgaard, L., & Landmark, B. (2014). Attending an activity center: positive experiences of a group of home-dwelling persons with early-stage dementia. *Clinical Interventions in Aging*, *9*, 1923.
- Stubbs, B., Eggermont, L., Soundy, A., Probst, M., Vandenbulcke, M., & Vancampfort, D. (2014). What are the factors associated with physical activity (PA) participation in community dwelling adults with dementia? A systematic review of PA correlates. *Archives of Gerontology and Geriatrics*, *59*, 195–203.
- Suttanon, P., Hill, K. D., Said, C. M., Byrne, K. N., & Dodd, K. J. (2012). Factors influencing commencement and adherence to a home-based balance exercise program for reducing risk of falls: perceptions of people with Alzheimer's disease and their caregivers. *International Psychogeriatrics*, *24*, 1172–1182.
- Tak, S. H., Kedia, S., Tongumpun, T. M., & Hong, S. H. (2015). Activity engagement: perspectives from nursing home residents with dementia. *Educational Gerontology*, *41*, 182–192.
- Takeda, M., Tanaka, T., Okochi, M., & Kazui, H. (2012). Non-pharmacological intervention for dementia patients. *Psychiatry and Clinical Neurosciences*, *66*, 1–7.
- Van Alphen, H. J., Volkers, K. M., Blankevoort, C. G., Scherder, E. J., Hortobágyi, T., & van Heuvelen, M. J. (2016). Older adults with dementia are sedentary for most of the day. *PLoS One*, *11*, e0152457.
- Woodcock, J., Franco, O. H., Orsini, N., & Roberts, I. (2011). Non-vigorous physical activity and all-cause mortality: systematic review and meta-analysis of cohort studies. *International Journal of Epidemiology*, *40*, 121–138.
- World Health Organization, 2010. *Global Recommendations on Physical Activity for Health*. World Health Organization, 1–58. Available: <http://www.who.int/dietphysicalactivity/publications/9789241599979/en/>.
- Yu, F., & Kolanowski, A. (2009). Facilitating aerobic exercise training in older adults with Alzheimer's disease. *Geriatric Nursing*, *30*, 250–259.
- Yu, F., Leon, A. S., Bliss, D., Dysken, M., Savik, K., & Wyman, J. F. (2011). Aerobic training for older men with Alzheimer's disease: individual examples of progression. *Research in Gerontological Nursing*, *4*, 243–250.