

Developing and evaluating an interactive app to support self-care among  
older persons receiving home care



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## **Abstract**

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The proportion of older persons worldwide is growing. With older age, complex health problems may occur and the need for home care increases. To support older persons to maintain health and self-care, innovative ways need to be developed. The aim of the project was to develop and evaluate an interactive app among older persons receiving home care. The project had several phases: i) to define and understand the problem ii) develop the intervention iii) develop and optimise evaluation. Qualitative and quantitative methods were employed. Data were collected through a scoping review, interviews with healthcare experts, older persons and nursing assistants (study I); interviews with older persons (studies II, III); focus groups with homecare nurses (study II). Questionnaires at baseline, end of intervention and 6-month follow-up; with instruments to assess aspects of health, health literacy, self-care, and a study specific question regarding sense of security were used (studies III-IV). Logged data from reported health concerns, alerts, and notes were collected (study IV). Data were analysed using qualitative content analysis (study I), thematic analysis (study II), qualitative content analysis with directed approach (study III) and descriptive and inferential statistics (studies III, IV). Results: Important aspects for health and self-care from the older persons' perspectives were described as: frame of mind, having relationships and social activities, physical ability and concerns, and maintaining self-care (I). These results were included in the app as questions with self-care advice, graphs and alerts to homecare nurses. The app use was described as an enabler for learning (II). The older persons showed improved communicative and critical health literacy at the 6-month follow-up (IV). They described an increased sense of security (II and III), which decreased at the 6-month follow-up (III). They expressed increased self-confidence (II) and support in self-care, but reported a decrease in self-care ability at the 6-month follow-up (III). App usage was high, with the health concern pain triggering the most alerts (IV). Their aspects of health were unchanged at the three assessments points (IV). In this context using an app may increase older persons' participation in their care. The results show that for some older persons, an app can be implemented as a tool for support in conventional home care.

*Keywords:* health concerns, mHealth, older persons, self-care

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## List of studies

This thesis is based on the following studies, which are referred to in the text with Roman numerals

- I. Göransson C, Wengström Y, Ziegert K, Langius-Eklöf A, Eriksson I, Kihlgren A, Blomberg K. (2017). Perspectives of health and self-care among older persons—To be implemented in an interactive information and communication technology-platform. *Journal of Clinical Nursing*, 26 (23-24): 4745-4755.
- II. Göransson C, Eriksson I, Ziegert K, Wengström Y, Langius-Eklöf A, Brovall M, Kihlgren A, Blomberg K. (2018). Testing an app for reporting health concerns—Experiences from older people and home care nurses. *International Journal of Older People Nursing*, 13(2) e12181.
- III. Göransson C, Wengström Y, Ziegert K, Langius-Eklöf A, Blomberg K. Self-care ability and sense of security among older persons when using an app as a tool for support. Submitted.
- IV. Göransson C, Wengström Y, Hälleberg-Nyman M, Langius-Eklöf A, Ziegert K, Blomberg K. Evaluating an app for older people - interaction, health and health literacy, a quasi-experimental study. In manuscript.

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## List of Abbreviations

ADL	Activities of Daily Living
App	Application
ASA-A	Appraisal of Self-Care Agency Scale
GDS-20	Geriatric Depression Scale
HI	Health Index
ICT	Information- and Communication Technology
mHealth	mobile Health
MRC	Medical Research Council
NUFFE	Nutritional Form For the Elderly
PIN	Personal identification number
PRO	Patient reported outcomes
S C & C HL	Swedish Communicative and Critical Health Literacy Scale
S-FHL	Swedish Functional Health Literacy Scale
SMS	Short Message Service
SOC	Sense of Coherence
WHO	World Health Organization

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## Introduction

The health of older persons is of increasing interest worldwide due to their growing proportion in the population and their longer life expectancy. As a result of this increased longevity, the total population of old persons is expected to double globally by 2050, with those over 80 years being the fastest growing group. Persons living in Sweden have one of the longest life expectancies in the European Union and worldwide. Furthermore, the health of the older persons is heterogeneous, with physical limitations and pain among the most common limiting factors in their daily lives. Today older persons perceive their health differently, with those under 80 years perceiving their health to be better than those over 80. As people grow older, the need for health care increases especially among the oldest old. Supporting their health brings about challenges that society, and in particular the healthcare system, needs to meet. Homecare services for older persons are expanding due to the older persons' needs that are more complex and health problems that are accentuated by their living in their own homes and the increasing proportion living alone. In order to meet this need, the development of digitalisation into a variety of different information- and communications technology (ICT)-innovations has taken place.

My experience of caring for older persons comes from 25 years of working as a registered nurse in the department of medicine at a hospital in southwest Sweden. During these years, I became interested in how to support in-patients with chronic obstructive pulmonary disease, and have developed and evaluated an intervention of a group-educational program with the same aim. When becoming a PhD-student at Örebro University with a base in Halmstad University and working in conjunction with the research group ICare at Karolinska Institutet, my research focused on older persons receiving home care and using an app.

# Background

## Ageing - different perspectives

Ageing is a slow normal process that begins already at birth (Cannon, 2015; Ferraro & Wilmoth, 2013). Different functions start to decline when a person is approximately 30-35 years old (Ferraro & Wilmoth, 2013).

The ageing process can be described from a variety of perspectives (Blomqvist, Edberg, Ernsth Bravell, & Wijk, 2017). From a physical perspective ageing can be described as one of deterioration such as failing eyesight and hearing (Sjölund, Nordberg, Wimo, & von Strauss, 2010; Wittich & Gagne', 2017), and a decreasing physical and functional ability (Milanović et al., 2013; World Health Organization, 2015a).

The biological perspective has several theories that address the complex ageing process, which questions if it is genetic and/or stochastic, i.e. small changes over a lifetime that result in damages (Lipsky & King, 2015). Getting older is also described as a chronological process, and according to the United Nations (2015) persons are considered old at age 60. The World Health Organization defines persons older than 65 years as old, even though it has been discussed from a global point of view that the limit ought to be set lower especially in less developed countries (World Health Organization, 2015b). Chronological old age can be described in three phases: young-old (65-74 years), old-old (75-84 years) and oldest-old (85 years and older) (Cannon, 2015).

Another perspective on ageing is the psychological, for example Erikson's theory that includes the idea of lifelong development and learning processes, and the ability to learn new things regardless of age (Wernher & Lipsky, 2015). Learning is described as being always possible and is essential for staying mentally active despite old age (Cohen, 2005).

From a social perspective, being old can be of value. With this perspective, an older person's capacity to control life and adapt to it is enhanced by their lifelong development and their social interactions (Ferraro & Wilmoth, 2013; Hasworth & Cannon, 2015). Ageing can also be described in subjective terms with the focus placed on a person's health and ability to perform activities rather than age (Cannon, 2015). In countries where being old is assigned a higher social status, older persons' subjective perceptions of their health is better (Marques et al., 2015).

In summary, these different perspectives address ageing solely from one standpoint and do not encompass a holistic view of becoming older. In recent decades, research and ideas have been reformed into new concepts for ageing.

### **The concept of healthy and active ageing**

The healthy ageing concept, which was introduced some years before the active ageing concept, highlights older persons' autonomy and their physical, cognitive, social and spiritual health (Hansen-Kyle, 2005). Healthy ageing is different in that it does not emphasise participation in society as such, but instead describes the person's interaction with the environment. This interaction depends on the older persons' functional abilities, which includes both their mental and physical capacities (World Health Organization, 2015a). Additionally, healthy ageing is different from active ageing, as it has a more biomedical approach (Hansen-Kyle, 2005) and highlights prevention and decreasing the risks linked to chronic conditions (World Health Organization, 2015a).

The framework active ageing, highlights older persons' opportunities for health, participation in society and their security. It focuses on aspects of their rights and equality instead of their needs. By recognising the variation in older persons and with an emphasis on their abilities, potential, and interest to participate in society; ageism may decline (World Health Organization, 2002). Moreover, active ageing highlights the importance of older persons maintaining autonomy and independence as a means to enhance their perceived quality of life (World Health Organization, 2002). One criticism of active ageing has been that it can be seen as not just encouraging older persons to work longer, but make them feel obliged to do so (Foster & Walker, 2014; Mendes, 2013). Finally, active ageing takes into consideration more factors that can affect the ageing process than the healthy ageing concept (World Health Organization, 2002).

It is my opinion that these two concepts encompass a more holistic view of older persons ageing. They emphasise that ageing can be a vibrant phase for older persons, and that they have the right to be included in the development of the society they live in.

## Older persons' health and self-care

### Older persons' health

Health is seen in this project from a holistic perspective, where the older person is seen as a unique individual and as a whole (Berg & Sarvimäki, 2003). Health can also be described by how persons have the ability to take care of their own needs and perform activities to maintain their health (Brulde & Tengland, 2003).

The WHO definition of health is *'a state of complete physical, mental and social well-being and not merely an absence of disease or infirmity'*, which is in accordance with the holistic perspective and the idea that health is both multi-dimensional and subjective (World Health Organization, 1948). However, the definition has been challenged in regard to the word 'complete', which could by definition exclude older persons living with specific chronic conditions (Huber et al., 2011). It has been proposed that the emphasis should be placed on a person's ability to adapt and self-manage so as to include the social, physical and emotional challenges in the definition of health (Huber et al., 2011).

Nevertheless, the definition by WHO has been developed into the Ottawa Charter for Health Promotion, which highlights the person's own resources and ability to reach a goal and take control over their own health (World Health Organization, 1986). The Shanghai Declaration developed this further by describing how health literacy plays an important factor in health and well-being (World Health Organization, 2016a). This development highlights the person as someone active in their health, which is congruent with what is used in this project rather than the WHO definition where health is a state.

It is important to see the person, and with the holistic theory of health the person is seen as having abilities and resources. This is dependent on the person's intention to reach vital goals given normal circumstances and within their cultural norms (Nordenfelt, 2007).

A focus on the person's ability together with a health perspective can be described from another point of view. According to the framework of International Classification of Functioning, Disability and Health (ICF), a person's ability to perform activities and participate in society hinges on environmental and personal factors (World Health Organization, 2001). In this framework a person's life situation is stressed, and it views functioning and disability as a dynamic interaction with health conditions (World Health Organization, 2001).

Presently, older persons in general have better health than previous generations, even with the variations seen in health today (Galenkamp et al., 2013; Jagger et al., 2016; Rechel et al., 2013). For example, the majority of older persons younger than 80 years of age perceive their health as good or very good (Kylén, Ekström, Haak, Elmståhl, & Iwarsson, 2014; Lagergren, Johnell, Schön, & Danielsson, 2016). The oldest old, aged 80 years or older, in comparison perceive their health as declining (Lagergren et al., 2016) and have complex health problems (Rechel et al., 2013).

It is proposed that it is crucial to maintain older persons' health to the best extent possible despite health problems (Chatterji, Byles, Cutler, Seeman, & Verdes, 2014; Steptoe, Deaton, & Stone, 2015). Common health problems described by older persons are for example, depression, fatigue, hearing impairment, insomnia and pain (Enkvist, Ekström, & Elmståhl, 2012; Josefsson, Andersson, & Erikstedt, 2016).

To enhance older persons' participation in their own health is essential, and to support self-care can be one aspect in such an endeavour.

### **Older persons' self-care**

With self-care, according to Orem's self-care deficit theory, the person is described as an agent who takes actions and performs activities in order to maintain their health. Self-care agency is an acquired complex ability that facilitates a person's achievement of better health and a better life (Orem, 2001). Self-care ability has also been described as having capabilities to perform activities in order to master life situations and manage health problems (Høy, Wagnar, & Hall, 2007).

Older persons have stated that self-care involves being physically, mentally and socially active, and the ability to maintain a healthy approach to life (Söderhamn, Dale, & Söderhamn, 2011). Self-care ability in older persons has been found to increase with good general physical and mental health, and with physical activity (Sundslí, Söderhamn, Espnes, & Söderhamn, 2012; Söderhamn, Lindencrona, & Ek, 2000). While on the other hand; increasing age, anxiety and receiving home care have been shown to decrease self-care ability (Sundslí et al., 2012).

Supporting older persons living in their own homes to maintain health is a way to enhance their self-care abilities (Høy et al., 2007; Söderhamn, Dale, & Söderhamn, 2013), and when needed to facilitate contact with healthcare professionals (Söderhamn et al., 2011). It has been concluded that by supporting the self-care of older persons living in their own homes

with for example home visits and telephone contact, their reported health can improve (Wong, Wong, Yeung, & Chang, 2018).

Self-care can also be viewed as a learning process (Høy et al., 2007; Orem, 2001) since self-care activities require the persons to have knowledge about themselves (Söderhamn, 2000). In addition, to have the ability to understand, critically appraise and apply health information to one's own situation is crucial in order to make appropriate decisions and perform activities that maintain or improve one's health (Mårtensson & Hensing, 2012; Nutbeam, 2008). This ability, also described as health literacy, is when a person receives additional knowledge and uses the information with the motivation to strengthen and conduct activities to maintain health and take better control of their own health (Ishikawa & Kiuchi, 2010; Nutbeam, 2008).

In summary, when supporting self-care among older persons it is important to consider their ability as well as how physically and mentally active they are. To facilitate and increase the interest for self-care activities there is a need to stimulate and motivate learning from their point of view.

## **Ageing in place**

Older persons want to live at home even though they have chronic conditions and complex health problems (Haak, Fänge Malmgren, Iwarsson, & Dahlin-Ivanoff, 2011; Ryan, McCann, & McKenna, 2009). They see the home as a meaningful place with memories and a place to perform meaningful activities (Haak et al., 2011; Sixsmith et al., 2014). There is an emotional attachment connected with one's own home (Stones & Gullifer, 2016), and that can be a reason why older persons prefer to live as long as possible in their own homes (Gillsjö, Schwartz-Barcott, & von Post, 2011). Furthermore, to be able to grow old in one's own home plays an essential role in one's identity and perception of independence (Sixsmith et al., 2014; Stones & Gullifer, 2016). The majority of older persons in Sweden live independently without informal or formal care in their own homes (Wimo et al., 2017). It has been an underlying principal in society in Sweden and other countries to facilitate the ability of older persons to live as long as possible in their own homes with support from spouses, family, home help or home care. Consequently, new demands are placed on the healthcare system to co-ordinate home care for older persons (Rechel et al., 2013; Steptoe et al., 2015).

## **Home care services**

The municipalities in Sweden are responsible by the laws set forth by the Health and Medical Services Act and the Social Services Act to offer home care services of good quality. These services are provided by the home care services organisation and performed by different professions such as registered nurses working as homecare nurses and physiotherapists (SFS 1982:763; SFS 2001:453). The goal of home care is to assist the persons at home, prevent infirmity, and replace hospitalisation and nursing homes (Drevenhorn, 2017). The most common service in home care is nursing care, such as caring for persons with wounds and performing pain assessments (The National Board of Health and Welfare, 2017). In recent decades home care has become a more prominent type of care in Sweden (Drevenhorn, 2017). During 2016 in Sweden, 221,000 older persons aged over 65 received homecare services (The National Board of Health and Welfare, 2018), which was approximately 12 % of the older persons in Sweden (Statistic Sweden, 2018). This is a result of the increasing proportion of older persons in the population, organisational aspects such as a decrease in the number of hospital beds and nursing homes, and as mentioned society's view to make it possible for older persons to live in their own homes despite health problems (Drevenhorn, 2017). The same has occurred in other countries as well, for example in the UK the proportion of older persons 85 years or older with high needs living in nursing homes has decreased from 73% in 1991 to 52% in 2011 (Kingston et al., 2017). Older persons today have more severe health problems compared to a decade ago when they would have moved into the nursing homes (Schön, Lagergren, & Kareholt, 2016). Consequently, it is essential that homecare services meet the older persons' needs, facilitate their involvement in home care, and strengthen their autonomy (Gregory, Mackintosh, Kumar, & Grech, 2017).

In conclusion, it is important that home care meets the older persons' increasing preferences of living in their own homes in order to support their integrity.

## **Gerontechnology**

The interdisciplinary field of gerontechnology research is directed towards ageing, technology and society (Graafmans, 2017), and it has undergone a rapid digital revolution in the last decade (McCallum, Agree, & Coppola, 2017). The foundation for it is the older persons' preferences, abilities and

experiences from daily life (Graafmans, 2017). To develop such technology that is both adapted to the older persons capabilities and their ageing process can be a challenge (Mayhorn, Rogers, & Echt, 2017).

The goal is to assist older persons to live as long as possible, and as independently and healthy as possible in their own homes (Graafmans, 2017) with the development and support of digital tools (McCallum et al., 2017).

## **Information- and communication technology (ICT)**

The digital development has resulted in various technologies in health care (McCallum et al., 2017). The use of ICT is of great interest worldwide and national strategies have been developed in regard to how to implement ICT in the healthcare system (World Health Organization, 2016b).

Further development of ICT has been in the area of eHealth, and there are numerous descriptions of it (Shaw et al., 2017). For example, to deliver health related information via different electronic devices, to function as a resource and service in health care (World Health Organization, 2016b) as well as to improve the healthcare system and access to it (World Health Organization, 2018). In Sweden, the government has set a goal to be a world leader in digitalisation and eHealth by the year 2025, and to use eHealth as a tool for improving participation, health and equality in health care (Governments and Swedish association of local authorities and regions, 2016).

One part of eHealth is mHealth, and according to WHO it is defined as *'the use of mobile wireless technologies for public health'* (World Health Organization, 2018). It is also referred to as the delivery of health-related services to patients, clinicians and caregivers through mobile platforms (McCallum et al., 2017).

The development of apps for smartphones or tablets has increased during the last decade, but there is a lack of evidence-based knowledge regarding the content and interactivity (Boudreaux et al., 2014; Martínez-Pérez, de la Torre-Díez, Candelas-Plasencia, & López-Coronado, 2013). In this thesis, the term app will be used for applications integrated in smartphones or tablets (Lewis, Boissaud-Cooke, Aungst, & Eysenbach, 2014).

The development of ICT as well as its implementation in health care is rapid. In this project, the focus is on mHealth and its use among older persons receiving home care.

### **MHealth and older persons**

The use of mHealth can support older persons' health by providing health information, as well enabling the assessment and monitoring of their health (World Health Organization, 2013). There are results that younger older persons can improve their independence with the use of mHealth, but overcoming the barriers in adapting mHealth to older persons can be challenging due to their poorer user ability and health literacy (Kruse, Mileski, & Moreno, 2017). Having good health literacy and being among the younger of the older persons have been shown to be associated with an increased interest for seeking health information via smartphones (Oh, Choi, & Kim, 2018).

It has been shown that the use of mobile phone and tablet apps can support self-care in populations with chronic obstructive pulmonary disease, diabetes and heart disease; and they can have a positive impact on specific disease outcomes (Swedish Agency for Health Technology Assessment and Assessment of Social Services, 2017). For example, older persons with heart failure described that the use of a web-based tablet could support their self-care (Buck et al., 2017). However, only half of the studies that showed self-care skills can be improved among older persons with specific chronic conditions used mobile phones or videophones, and in half of those studies the participants had a mean age of 65 years or younger (Guo & Albright, 2017). Therefore, it appears that, to use mHealth as a support for self-care is common for persons with specific chronic conditions, but there is a deficiency in its ability to target older persons and their diverse health problems, which in this growing population is greatly needed.

In a review of studies made among persons with specific chronic conditions living at home who used a smartphone to report health problems, there was a reported increased participation in health management, but the proportion of older persons was small (Wang et al., 2014). Similarly, results regarding interventions using smartphones for persons with chronic conditions, reported the lack of older persons (Kim & Lee, 2017). Even though there are studies conducted using mHealth that target older persons managing their chronic conditions, the results show that for older

persons receiving home care the use of mHealth is limited (Matthew-Maich et al., 2016). Furthermore, the importance of the involvement of older persons in the developmental phase in order to increase their acceptability and feasibility of apps has been ascertained (Jongstra et al., 2017).

I consider the low proportion of older persons included in studies to be interesting as they are the most frequent users of health care as well as home care due to their health problems, and that the healthcare system needs to strive for resource equality in the population.

Therefore, to support older persons living at home and receiving home care, it is necessary to develop and evaluate interactive apps that are based on their needs and preferences as well as being evidence-based.

# Theoretical framework

## Participatory care

The theoretical foundation of this project is based on the older persons' perspectives, values and preferences on what supports them in their health and self-care and increases their participation in their care. From my point of view, it is essential to facilitate ways for older persons to become more integrated and active partners in the healthcare team, instead of passive receivers of care.

The concept of patient participation in health care has been explored in recent decades in order to highlight the patient's role in health care (Cahill, 1998; Eldh, Ekman, & Ehnfors, 2010; Lyttle & Ryan, 2010; Sahlsten, Larsson, Sjöström, & Plos, 2008). In Sweden, the government has stipulated by law the patient's right for increased participation in their own health care (SFS 1982:763; SFS 2014:821). Despite this, it has been found that older persons 65 years or older in Sweden, were the least involved in their care compared to other countries in an international study on health care from older patients' perspectives (Vårdanalys, 2017).

Patient participation is described as the patient's involvement and having knowledge regarding their health and care, as well as their interaction with healthcare professionals (Eldh et al., 2010). It appears, that getting older persons more active in their care not only depends on receiving knowledge and on having confidence, but also on their health (Angel & Norup Frederiksen, 2015). It also depends on a need to respect their autonomy and to what degree they want to participate (Angel & Norup Frederiksen, 2015; Lyttle & Ryan, 2010). Furthermore, an older person's participation is also determined by the nursing practices that facilitate it (Lyttle & Ryan, 2010) and the power and control relinquished to allow it (Sahlsten et al., 2008), together with the goal of reaching an equality between the person and the healthcare professionals (Thórarinsdóttir & Kristjánsson, 2014). In this project I consider a more equal and mutual interaction between the older person and the homecare nurse is something to strive for, one in which the older person has access to knowledge and therefore is able to be active and take control of their own health and care based on their own preferences.

Further development of the patient participation concept has led to the concept of person-centred care. Person-centred care highlights a partnership, i.e. the person's perspective of their own situation as well as partici-

pation in the shared decision making related to their care (Ekman et al., 2011). Moreover, during this decade an international patient organisation has emerged that focuses on the promotion of person-centred health care through encouraged involvement (International Alliance of Patients' Organizations).

In other words, to adopt a person-centred approach is to have the older person's perspective of what is seen as a problem and what that person values in life (Blomqvist et al., 2017). Accordingly, older persons receiving home care have described the lack of opportunities from the healthcare professionals to be involved in their home care or the decision-making regarding it (Róin, 2017). However, research studies are being conducted with the aim of evaluating person-centred care that is related to the health of older persons living in their own homes receiving home care (Bölenius, Lämås, Sandman, & Edvardsson, 2017). A literature review also showed that person-centred care or supporting self-care can have an impact on health outcomes related to patient participation (Swedish Agency for Health Technology Assessment and Assessment of Social Services, 2017).

The difference between the concept patient participation and person-centred care is that self-care is not a prominent aspect in person-centred care (Ekman et al., 2011). In patient participation, self-care is referred to as being more of an essential part of the care for older persons (Eldh et al., 2010). Additionally, self-care is described as something active, and highlighted as taking action in one's own health (Sahlsten et al., 2008; Thórarinsdóttir & Kristjánsson, 2014).

Finally, I consider that these concepts together reinforce each other and give the prerequisites to create home care that strengthens the older person role regarding their health and self-care.

### **The development of the app**

The app in this project is based on patient reported outcomes (PRO), in which persons themselves report perceived health problems, levels of functioning, and health related quality of life directly to healthcare professionals (U.S Department of Health Humans Services, 2006). The use of PRO has been shown to facilitate dealings regarding health problems in the areas of communication between the patient and healthcare professionals, and with the shared decision-making processes (Snyder & Aaronson, 2009; Valderas et al., 2008). The development of PRO and reporting it electronically in clinical practice is increasing. However, the development needs to target

the appropriate population as well as use validated instruments for data collection (Coons et al., 2015). The implementation in different settings also needs to consider when and how to access health problems and if alert systems should be incorporated (Snyder et al., 2012).

In a collaboration between Karolinska Institutet and a Swedish company (Health Navigator), an interactive app was developed. The foundation for the app was that it should include several components.

First, the persons make a report based on questions of pre-defined health problems designed like a standardised questionnaire that addresses occurrence, frequency and the distress level associated with the health problems (Browall, Kenne Sarenmalm, Nasic, Wengström, & Gaston-Johansson, 2013; Portenoy et al., 1994). When a health problem is reported as being present, it generates follow-up questions that rate the frequency as ‘almost always’, ‘often’, ‘sometimes’ or ‘almost never’ and the distress level as ‘very much’, ‘pretty much’, ‘a little’ or ‘not at all’. These reports are made directly available to the healthcare professionals via a connection to a monitoring web interface. Logged data are stored on a secure server.

The app also includes a risk assessment model that is triggered by the severity of the health problems and sends alerts to healthcare professionals. There are two kinds of alerts, yellow and red, depending on the severity of the frequency and distress levels, which are indications to the healthcare professionals that contact should be made with the older person. The healthcare professionals automatically receive a short message service (SMS) to their mobile phone when an alert is triggered. In the more recent version, there is a possibility for the persons to send free-text comments.

Additionally, the app includes continuous access to evidence-based self-care advice related to the reported health problems and links to relevant websites for more information. Finally, the history of reported health problems can be viewed in the form of graphs for the person and healthcare professionals.

The app is generic and the content of the health problems, self-care advice and alert system is developed for each specific target population. The app has been evaluated in persons with prostate cancer receiving radiotherapy, and it was found that the reports were easy to make and the content was relevant (Langius-Eklöf et al., 2017; Sundberg, Langius-Eklöf, Blomberg, Isaksson, & Wengström, 2015). Those in the intervention group using the app were also found to report less symptom burden than

those who did not use the app (Sundberg et al., 2017). Other studies that also included persons with prostate or pancreatic cancer described that enhanced participation could be achieved with the use of the app (Gustavell, Langius-Eklöf, Wengström, Segersvärd, & Sundberg, 2018; Hälleberg-Nyman et al., 2017).

## Rationale

The growing proportion of older persons in the population worldwide is of great concern. The majority of the younger old have good health, but the oldest old have more complex health problems and health care needs, which leads to a need for home care. There is a challenge to support older persons as they are a heterogeneous group with variations and fluctuations in their health status and self-care abilities. Therefore, there is a need to obtain deeper knowledge and understanding of what older persons perceive as important for their health and self-care.

To support persons in the maintenance of their health and to assist them in the performance of appropriate self-care activities is one of the aims of nursing. Research such as intervention studies are needed to gain knowledge regarding how older persons' health and self-care activities can be strengthened.

There has been research in other fields with interventions targeting persons living at home with specific chronic conditions where reporting via an app in a smartphone was used to communicate health problems to healthcare professionals. However, few of the studies included the oldest old and older persons receiving home care. Today in home care, face-to-face encounters between the older persons and the homecare nurses are decreasing due to lack of resources, time and staffing. Consequently, it is essential to develop and implement innovative ways to support older persons, enhance the interaction between them and the homecare nurses as well as to plan for variations in the organisation of home care. As digitalisation in society increases, new technology such as mHealth should be tested as a complement to regular home visits and telephone contact. This should be done in order to create innovative supportive practices in home care that can be used to support the health and self-care of older persons.

# Aim

The overall aim of this thesis was to develop and evaluate an interactive app among older persons receiving home care.

## Specific aims of the studies

I. The goal was to develop the content to be included in the interactive ICT-platform by exploring health concerns and self-care identified by literature, healthcare professionals and the older persons themselves.

II. The aim was to explore the experiences of using the Interaktor app among older people with home-based health care and their nurses.

III. The aim was to describe and evaluate the experiences of self-care support and sense of security among older persons using an app to report health concerns.

IV. The aim of the study was to describe how older people use an app to report health concerns and to evaluate the impact of the app on aspects of their health and health literacy over time.

# Methods

## Design

The design of this project had a stepwise approach that was underpinned by the Medical Research Council's (MRC) complex intervention evaluation framework (Campbell et al., 2007; Craig et al., 2008). The framework's steps used in this project, were to: i) define and understand the problem and the context, ii) develop the intervention, and iii) develop and optimise the evaluation (Campbell et al., 2007).

Qualitative as well as quantitative methods have been used, which have been previously advocated for the evaluation of interventions within health care (Williams, May, Mair, Mort, & Gask, 2003).

A descriptive design was used to identify areas relevant to health and self-care from the older persons' perspectives to be included in the app (study I). An explorative design was used to explore older persons' and homecare nurses' experiences of using the app (study II). A quasi-experimental design was applied to describe and evaluate older persons' self-care support and sense of security (study III) and to describe their use of the app and evaluate the impact on aspects of their health and health literacy (study IV), see Table 1.

Table 1. Overview of the designs, participants, data collection and data analysis of the studies included in the project

Study	Design	Participants	Data collection	Data analysis
I	Descriptive	Healthcare experts ( $n=5$ ) Older persons ( $n=8$ ) Nursing assistants ( $n=7$ )	Individual Interviews Literature (20 articles)	Qualitative inductive content analysis
II	Explorative	Older persons ( $n=17$ ) Homecare nurses ( $n=12$ )	Individual interviews Focus groups	Thematic analysis
III	Quasi-experimental	Older persons ( $n=17$ )	Questionnaires Individual interviews	Descriptive and inferential statistical analyses Directed content analysis
IV	Quasi-experimental	Older persons ( $n=17$ ) Homecare nurses ( $n=12$ )	Logged data Questionnaires	Descriptive and inferential statistical analyses

## Sample and settings

### Study I

#### Literature review

A scoping review was conducted to identify areas relevant to health and self-care from the older persons' perspectives.

#### Healthcare experts, older persons and nursing assistants

Healthcare experts with long clinical and/or research experience within the field of health care with older persons were strategically identified in order to reach a broad sample with variation aimed to answer the research question (Creswell, 2013). An invitation to participate and information regarding the study's aim were sent by email to seven persons. Five (three women aged 55-80 and two men aged 55-70) agreed to participate in individual interviews. They were professors in nursing ( $n=1$ ) and in rehabilitation techniques for older persons ( $n=1$ ), a geriatric physician ( $n=1$ ), a physician and associate professor in general medicine ( $n=1$ ), and an expert from The

National Board of Health and Welfare who also had specialised health care experience with older persons ( $n=1$ ).

The individual interviews with the older persons and nursing assistants were from a previous project that was led by one of the co-authors and had an aim to develop and understand what a meaningful day consists of for older persons receiving home care (James, Blomberg, Liljekvist, & Kihlgren, 2015). From this study, interviews with older persons ( $n=8$ ) living at home receiving homecare services or living in nursing homes, and nursing assistants ( $n=7$ ) were selected for a secondary analysis (Heaton, 2004). The older persons were aged 83-100 (mean 92) and the nursing assistants were aged 24-60.

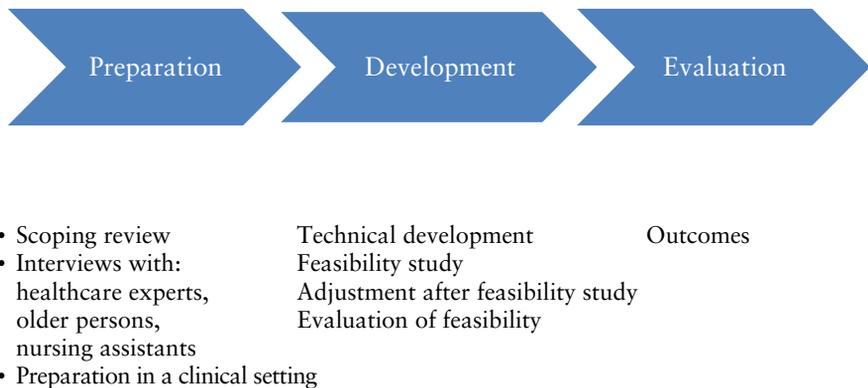


Figure 1. The project development following the Medical Research Councils's framework

## Development of the app – older persons’ home care version

The contents in the app were developed to meet the older persons’ preferences, and were based on an earlier study (Algilani, Langius-Eklöf, Kihlgren, & Blomberg, 2017) and the results from study I. The results were the basis for the formulation of the health concerns to be assessed in the app. The assessment of the included health concerns had the same structure regarding occurrence, frequency and distress levels as described in the aforementioned versions. The app immediately transmitted the reports of health concerns from the older persons to the homecare nurses’ computer web interface.

The risk assessment model was developed and based on literature in nursing and medicine. The final version was discussed with a geriatric physician. The possible alerts were constructed as one or a combination of health concerns together with the reported frequency and distress levels. In total, six single possible alerts were constructed: constipation, difficulty eating, diarrhoea, dizziness, fever and pain. When the older persons reported these health concerns as either ‘almost always’ or ‘often’ in frequency and at a distress level of ‘very much’ or ‘pretty much’, alerts were triggered. One possible alert consisted of three health concerns combined, i.e. constipation, fever and loss of appetite together with ‘almost always’ in frequency and ‘very much’ in distress. Additionally, a history of the health concerns could also trigger alerts, i.e. the older person reporting the same health concern(s) repeatedly for consecutive days. For example, having reported fever more than twice or sadness once previously generated alerts. A history with a combination of health concerns resulted in three different possible alerts; the first with difficulties eating, diarrhoea and dizziness, the second with fever and dizziness and the third with diarrhoea and fever. With a second reporting of any of these three, an alert was triggered.

There were two levels of alerts. For less severe health concerns, there were yellow alerts that indicated contact should be made by the homecare nurses within 24 hours. For more severe health concerns, there were red alerts that indicated contact should be made the same day. For example, when the older persons reported diarrhoea as ‘almost always’ in frequency and ‘very much’ for the distress level, a red alert was triggered. A yellow alert was sent when a report of diarrhoea and fever for the second time with a frequency of ‘sometimes’ and a distress level of ‘little’ was made.

The homecare nurses automatically received a SMS on their mobile phone that an alert had been sent regarding the kind of alert and health

concerns. Information regarding the type of alert and health concern could also be read on the nurses' work computers. The older persons could also choose to send an optional SMS to the homecare nurses when they had triggered an alert.

All the included self-care evidence-based advice and links for more information, were identified as targeting older persons and were provided by the Swedish national public health help online (Vårdguiden 1177, 2017). When the older persons had reported a severe health concern, the relevant self-care advice was shown directly on the screen in the app, so that they did not have to search for it.

Both the homecare nurses and the older persons could follow the history of reported health concerns on graphs via the computer's web interface or on the app.

After the homecare nurses had contacted the older person regarding the alert, notes were made in the system about the action taken in regard to the reported health concern.

## **Studies II - IV**

Older persons and homecare nurses included in the intervention

The intervention was conducted in two municipalities in southwestern Sweden, one in an urban area and one in a rural area, during May 2014 to June 2015. The healthcare managements responsible for the organisation of the home care in both municipalities granted permission for the study. The homecare nurses received verbal and written information regarding the study and instructions on how to use the web interface. They signed a written consent.

Older persons that met the inclusion criteria: 65 years or older, living in their own home, receiving home care and were cognitively able; were invited to participate in the intervention. From the homecare nurses and through a meeting held at a local venue in one of the municipalities, 76 older persons were identified that fulfilled the criteria. The homecare nurses and one of the researchers provided them with verbal, written and contact information. From those, 51 agreed to participate in the study and mailed the contact form in a prepaid envelope to the researcher. Further contact and plans for home visits were then made. When contact was made to plan the home visit, 19 older persons declined to participate due to illness, poor eyesight, or lack of prior experience. The remaining 32

older persons received information about the smartphone or tablet and the app in their homes and gave their written consent, but eight decided at that point that they did not want to participate due to poor eyesight and lack of interest. In total, 24 older persons started the study, but five dropped out due to health problems and lack of interest. From the remaining 19 participants, two deceased during the study period, which left 17 who completed the study, see Figure 2. All of the homecare nurses ( $n=12$ ), responsible for the older persons agreed to participate and were included in the study.

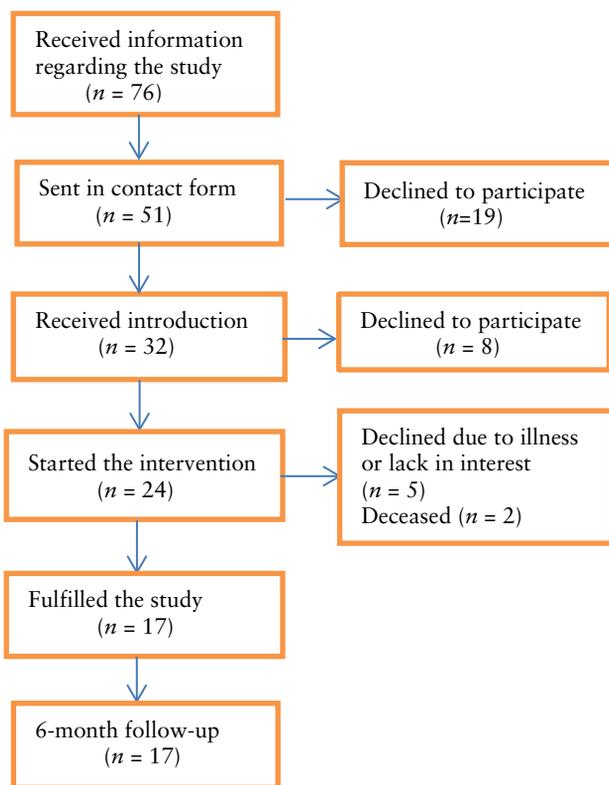


Figure 2. Flow chart over older persons' participating in the intervention

## Procedure of the intervention

The three-month intervention began with home visits in which the researchers repeated the information about the study and the possibility to withdraw at any time without having to give a reason. The older persons signed the written consent and were provided with a smartphone/tablet that had the app preinstalled. They received an individual personal identification number (PIN-code) to the smartphone/tablet. The selection of either a smartphone or tablet depended on the two different locations of the municipalities. The older persons also received an individual PIN-code to log in to the app as well as an identification number to secure confidentiality. The researchers gave written information and instructions for the smartphone/tablet and app using screenshots of reports, self-care advice and graphs. Additional information and support was available by calling the researcher at the phone number supplied. The older persons were informed that they should continue to contact their homecare nurses as usual when needed for example, on the weekends or in acute situations. During the first visit, the older persons made a test report in order to familiarise themselves with the smartphone/tablet, app and questions.

The older persons were requested to make reports of their health concerns twice a week (Monday and Thursday) and more often if needed weekdays. Twice a week was considered an appropriate amount based on the results of a prior study (Algilani et al., 2017). The reason for not reporting on weekends was due to organisational factors related to the larger proportion of older persons to homecare nurses on the weekends. The older persons received a reminder in the app if they had not sent a report by 13.00 Monday and Thursday.

The older persons were given information and instructions regarding the self-care advice that also included links for further reading and information regarding the graphs so that they could follow the reported health concerns. They were informed that when reporting the severity of health concerns, relevant self-care advice would be shown in the app. Additionally, they were told that when they reported a severe health concern an automatic alert would be generated and sent to their homecare nurse, who would phone them to arrange further contact. The older persons could also send an optional SMS with a triggered alert. The researcher phoned the older persons during the first weeks, approximately every 14 days and made home visits if additional support was needed.

The homecare nurses received information regarding the study, and the possibility of withdrawing at any point without having to give a reason.

They received written information and instructions regarding the web interface, alerts and notes. They received a PIN-code to use to log in via a computer onto a web interface to view the older persons' reports and graphs. They could also take care of the alerts and make notes of the actions that were made because of the alerts. The researchers also had access to the older persons' reports via an individual log in PIN-code.

## **Data collection**

### **Scoping review**

The focus of the scoping review was to summarise findings in the literature according to the six phases described by Armstrong, Hall, Doyle, and Waters (2011). To identify relevant studies, searches were conducted in the electronic databases CINAHL, PsycINFO, PubMed, Social Services Abstracts and Sociological Abstracts. The search terms were related to older persons, health and self-care. The search for health status; ('older people' OR 'older persons' OR 'older adults') AND (exp\*) AND (perceptions) AND (health status), and the search for self-care; ('older people' OR 'older persons' OR 'older adults') AND (exp\*) AND (perceptions) AND (self-care). The limitations of the search were 'English language' in all of the databases with the addition of '65 years' in CINAHL, Psych-INFO and PubMed. The date limitation was set between 2000 and 2016 to capture published articles with extensive and new findings. The inclusion criteria were >65 years and findings based on the older persons' perspectives on health and self-care. The exclusion criteria were studies with older persons having impaired cognition.

With the term health status, the search yielded 119 articles, and after removing the duplicates, 45 of these articles had titles related to the aim. Articles that focused on the next of kin or specific diseases were excluded. After reading the abstracts and excluding those that focused on hospital readmissions or ocular disease, there were 22 articles. The remaining articles were read in full and after excluding integrative review articles or those dealing with different health-measures, 15 articles were included.

The search for self-care revealed 29 articles, and after the duplicates were removed, there were 19 with titles relevant to the aim. The same process for article inclusion as described above was applied. Articles that had a focus on specific diseases or psychometric studies were excluded. A

total of five articles focusing on self-care remained for inclusion. In total 20 articles were included in the scoping review, see Figure 3.

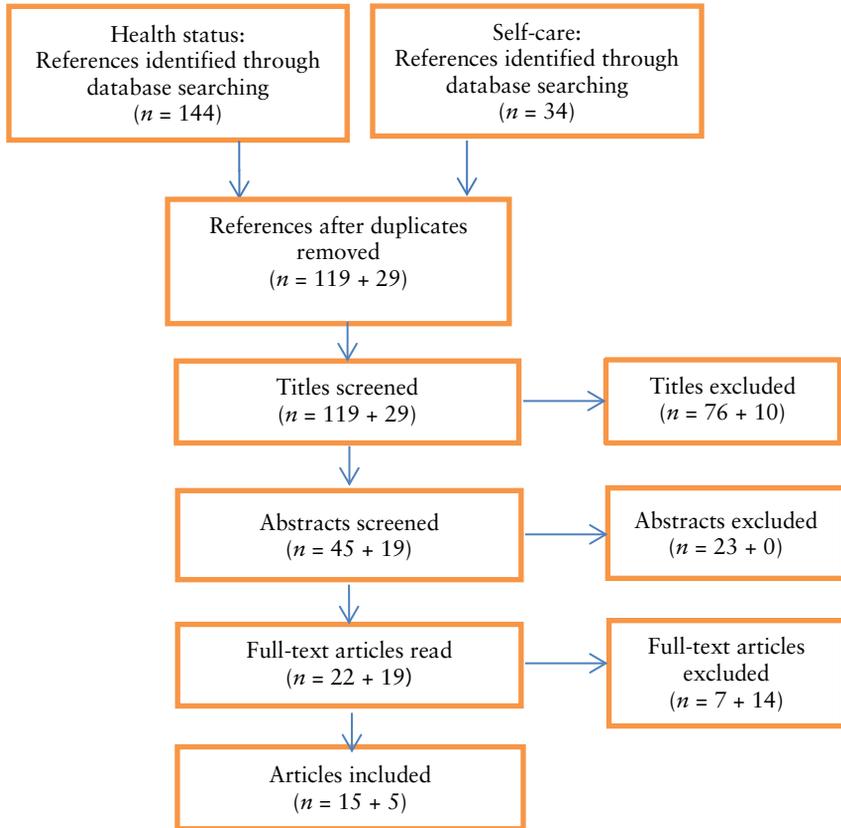


Figure 3. A flowchart over the literature search

## Interviews

Individual and semi-structured interviews with healthcare experts (study I) were conducted per their choice via telephone ( $n=3$ ) or in person at their workplace ( $n=1$ ) or via email ( $n=1$ ). The interviews were guided according to Kvale and Brinkman (2009). All interviews started with an open question; 'What do you think is important for older persons to perceive health'. The interviews focused on the participants' knowledge and experiences as clinicians and researchers in the areas of importance and rele-

vance to older persons' health and self-care. Notes were taken by the researchers during the interviews and were written into the interview guide templates directly after the interviews. The email conversation conveyed relevant and important information. The interviews lasted between 30-60 minutes.

Individual semi-structured interviews were conducted after the intervention (studies II and III) with the older persons ( $n=17$ ), who had reported health concerns via the app. The interviews were conducted in the older persons' homes, as they requested. An interview guide was developed (Kvale & Brinkmann, 2009), to explore their experiences of using the app. The interviews started with an open question; 'Can you describe how it has been to use this smartphone/tablet'. Further questions were asked according to the interview guide such as; 'Can you describe your experience of using the app', 'Can you describe your experience of reporting health concerns' and 'How have you used the self-care advice'. A probing question such as, 'Can you give an example' was asked when further explanation was desired to enable a deeper understanding. The interviews lasted approximately 15-60 minutes and were all audio-recorded.

The four different focus groups with the homecare nurses ( $n=12$ ) (study II) were conducted at their workplaces and at a time chosen by them. Focus groups were chosen as they take advantage of the group dynamic to access rich information (Kitzinger, 1994). An interview guide was developed (Kvale & Brinkmann, 2009) that included questions regarding their experience of using the web interface and receiving alerts. The questions in the focus groups were 'What is your experience of using this system', and 'Can you describe your experience of receiving an alert'. An additional probing question such as, 'Can you give an example' was also asked. The discussions during the focus groups were led by a moderator and a co-moderator that encouraged any passive participants to take part. The co-moderator also made notes of the non-verbal communication observed during the discussion. The audio-recorded focus groups lasted 30-45 minutes. All the interviews and focus groups were transcribed verbatim by the author of this thesis.

## **Questionnaires**

The older persons received a questionnaire at baseline, at the end of the intervention and at a 6-month follow-up. The following instruments were included; Appraisal of Self-care Agency scale (ASA-A) (Söderhamn, Evers, & Hamrin, 1996a), Geriatric Depression scale (GDS-20) (Gottfried,

Noltorp, & Nørgaard, 1997), Health Index (HI) (Forsberg & Björvell, 1993), Nutritional Form for Elderly (NUFFE) (Söderhamn & Söderhamn, 2001), Sense of Coherence (SOC) (Eriksson & Lindström, 2005), The Scale for Functional Health Literacy (Swedish FHL Scale) (Wångdahl & Mårtensson, 2015) and The Swedish Communicative and Critical Health Literacy scale (Swedish C & C HL scale) (Wångdahl & Mårtensson, 2014). A study specific question concerning their sense of security during the previous week was also included.

To evaluate the older persons' self-care ability and sense of security (study III), one instrument and the study specific question were used. The ASA-A scale includes 24 items of self-measurement, of engagement, and power in self-care activities (Söderhamn et al., 1996a). It has a Likert scale with five response alternatives from 'totally disagree' to 'totally agree'. Nine of the 24 items are negatively phrased and their scores are reversed in the total score. Scores can range between 24 and 120 points, with a higher score indicating a better ability to perform self-care activities. The ASA-A scale (Söderhamn et al., 1996a) has been validated (Söderhamn, Lindencrona, & Ek, 1996b) and used with older persons and in a variety of settings such as in persons' own homes and geriatric rehabilitation facilities (Evers, Isenberg, Philipsen, Senten, & Brouns, 1993; Lorensen, Holter, Evers, Isenberg, & Van Achterberg, 1993).

The study specific question was 'Do you experience a sense of security in your daily life', which had seven response alternatives from 'totally disagree' to 'totally agree' on a Likert scale.

A number of instruments were used to describe the older persons' aspects of health (study IV). The Geriatric Depression scale (GDS-20) (Gottfries et al., 1997) with 20 items screens for depression in older persons and has a dichotomous yes/no answer. A total score of zero to five indicates depression is not likely, and a score of 6-20 indicates depression can be suspected. The GDS-20 has shown to have validity and reliability among older persons at risk for depression (Gottfries et al., 1997). In its original 30 item self-rating form, it has been shown to be valid and reliable among older persons when screening for depression (Yesavage & Brink, 1983). A shorter form, GDS 15 has also been shown to be valid and reliable for screening older persons for depression (Sheikh & Yesavage, 1986).

Health Index (HI) is a generic instrument with nine items regarding general health (Forsberg & Björvell, 1993). It has a Likert scale with four response alternatives ranging from 'very poor' to 'very good'. The total

score has a minimum of nine and a maximum of 36, with higher scores representing better health. The HI has been used in hospital settings as well as in urban populations and it has been shown to have valid and reliable properties (Forsberg & Björvell, 1993; Nordström, Nyman, & Theorell, 1992).

The Nutritional Form for Elderly (NUFFE) (Söderhamn & Söderhamn, 2001) is used for the nutritional screening of older persons. It has 15 items and 3 response alternatives on a Likert scale (zero to two points/item). With a score between 0-5, there is a low risk for undernutrition. A score of 6-12 indicates a moderate risk for undernutrition and 13 and above indicates a high risk. It has shown to be a valid and reliable instrument for older persons in different settings (Söderhamn & Söderhamn, 2002).

The Sense of Coherence scale (SOC) measures a global orientation to life, and is based on meaningfulness, manageability and comprehensibility (Eriksson & Lindström, 2005). It has 13 items with seven response alternatives on a Likert scale. Five items are negatively stated and reversed in the total score. The minimum score is 13 and the maximum is 91, where a higher total score indicates better perceived health in general. The SOC has been described as valid and reliable in several settings and populations (Eriksson & Lindström, 2005; Langius & Björvell, 1993).

The Swedish C & C HL Scale includes five items and focuses on one's ability to extract, process and apply information to improve health (Wångdahl & Mårtensson, 2014). The scale has a Likert scale with five response alternatives ranging from 'totally disagree' to 'totally agree'. The total score ranges between 5-5000 points with a lower score representing better skills to critically analyse information. The scores are summarised and sorted into the categories inadequate, problematic or sufficient (Mårtensson & Wångdahl, 2017a). It has shown content validity and reliability (Wångdahl & Mårtensson, 2014).

Finally, the Swedish FHL Scale (Wångdahl & Mårtensson, 2015) assesses the ability to read and understand information necessary for being able to function in a healthy manner. It consists of five items with five response alternatives on a Likert scale ranging from 'never' to 'often'. The total score ranges between 5-5000 points with a lower total score indicating a better level of understanding health related information. The scores are categorised into inadequate, problematic or sufficient functional health literacy (Mårtensson & Wångdahl, 2017b). It has shown content validity and reliability (Wångdahl & Mårtensson, 2015).

## **Logged data**

Logged data from the older persons use of the app, i.e., the reported health concerns with their occurrence, frequency and distress levels, and the triggered alerts gathered from the older persons ( $N=17$ ) during the three-month reporting period were collected (study IV). The older person's report usage was calculated by adding the number of days an older person submitted a report and then dividing by the number of days they were supposed to make a report, which was then presented as a percentage. Additionally, the logged data such as notes made by the homecare nurses after receiving alerts during the same three-month period were included. All the logged data were extracted in a pivot table from the database stored in a secure server.

## **Data analysis**

### **Qualitative content analysis**

The analysis of the literature from the scoping review, interviews with healthcare experts and interviews with the older persons and nursing assistants (study I) was a parallel and iterative process between the three sources.

The literature from the scoping review was organised in a matrix (Armstrong et al., 2011). The matrix included authors, year of publication, country, study design, method, study population and older persons' perspectives on health status and self-care.

All data were analysed by qualitative content analysis with an inductive approach (Elo & Kyngäs, 2008). The analysis started by reading the data repeated times to obtain a sense of the whole. Then, text units relevant to the aim were identified and coded depending on the meaning of the text. The codes were grouped into preliminary categories based on the similarities and differences. These were discussed by the researchers and resulted in four categories.

### **Thematic analysis**

Thematic analysis on a latent level with an inductive and deductive approach was used (study II) to identify, analyse and report patterns in the data (Braun & Clarke, 2006). An inductive approach was chosen in order to capture the older persons' experiences of using an app. For the

homecare nurses' experiences, a deductive approach was employed using the results of the older persons' experiences as a guide.

The analysis began by the researcher of this project reading the transcripts of the interviews several times in order to become familiar with the data and search for patterns. In a process with all of the researchers, the text relevant to the older persons' experiences was initially coded in preliminary codes and then collated. The collated codes were sorted into potential and broader subthemes depending on similarities and differences. This led to four sub-themes, which described the older persons' experiences of using the app.

These four subthemes were then used when a deductive analysis of the focus groups was conducted. The data extracts relevant to the aim, were coded according to these four sub-themes. A new additional fifth sub-theme was identified based on data that did not fit into the previous four sub-themes. The five subthemes were crosschecked with the complete data set. An overarching theme was identified, which was based on the five subthemes. The analysis process was conducted and discussed by all of the researchers.

### **Directed content analysis**

A directed content analysis was used to describe the older persons' experiences of self-care support and sense of security using the app (study III). Directed approach is used to interpret a phenomena that would benefit from further description (Hsieh & Shannon, 2005). This was chosen to achieve a more complete understanding in combination (Malterud, 2001) with the included measurements and interviews.

To start the analysis, all of the interviews were read repeatedly to obtain a sense of the data as a whole. The analysis was then directed by the predetermined codes of the descriptions of how self-care was supported and experiences regarding sense of security, when searching for identified text in the transcribed interviews. The identified text was coded according to the meaning and then sorted based on similarities and differences between the codes. Two of the researchers discussed the preliminary results and were critically reviewed by the research group in order to achieve trustworthiness.

## **Statistical analysis**

Descriptive statistics of the older persons' demographics (studies II-IV) were calculated. Descriptive and inferential statistical analyses appropriate for the data level and distribution were used (studies III-IV). As data were not normally distributed and the variables were on a nominal or ordinal level, non-parametric tests were chosen (Altman, 1991).

To measure the difference over all three times, the Cochran's Q test and Friedmans test were used. To estimate the differences for the older persons between the three times, the McNemar test and Wilcoxon signed rank test were used (Altman, 1991).

In a few questionnaires at the three assessment points there were missing internal data, in total less than 5 %, for random single items. Therefore, the small sample size and missing data lead to no imputation of data (Bland, 2015).

The data were processed and the statistical analyses were conducted using the Statistical Package for the Social Services (SPSS) version 24 (SPSS Inc, 2017). All statistical tests were set to a significance level at 0.05 (two-tailed).

## Ethical considerations

The project was conducted according to the principles of the Helsinki Declaration (World Medical Association, 2013). It also followed the Swedish act concerning the Ethical review of research involving humans (SFS 2003:460, 2003).

It was a requirement to respect the older persons' autonomy, confidentiality and integrity throughout the studies. Older persons can be considered a vulnerable group, which was taken into account and led to the secondary analysis of previously conducted interviews with older persons (study I). In those interviews, rich descriptions of the older persons' perspectives regarding perceived health in their daily life were identified.

The enrolment of eligible older persons in this project was thoroughly discussed by the researchers. Participation in this study was considered to pose minor harm to the older persons, since they would receive their conventional home care and the use of an app would be a complement to that care. To provide the same opportunity to all of the older persons, a smartphone or a tablet was supplied by the researcher. With this approach, selection bias was prevented. To minimise unexpected effects for the older persons using the app during the intervention, the researcher had telephone contact and conducted home visits when the older persons requested.

The homecare nurses identified the older persons that met the inclusion criteria, and gave verbal and written information regarding the study, as well as the contact form to the eligible older persons. In Sweden, the identity of persons receiving home care is protected. By having the homecare nurses introduce the project, the integrity of the older persons was preserved. However, they might have found it more difficult to decline participation since they had a relationship with the homecare nurses. The older persons might have been less influenced either way if an external researcher had been the one that initially approached them regarding participation, but then their integrity would not have been preserved.

In the interviews with the older persons, it was also important to ensure a comfortable atmosphere, for example they chose the time and place, which were at their request in their homes.

At the end of intervention, the older persons returned the smartphone or tablet to the researcher. Some of the older persons expressed a desire to keep the tablet at this time point. To discontinue the opportunity the smartphone or tablet created for the older persons can be seen as unethical

(Mort, Roberts, Pols, Domenech, & Moser, 2015), but the older persons were instructed to use the previous forms of contact such as telephoning the homecare nurses or contacting the home help staff when needed.

Confidentiality was guaranteed and all of the data was treated according to the Swedish data protection act (SFS 1998:204, 1998), which was in effect at that time. The General Data Protection Regulation (Datainspektionen, 2016) has since replaced the Swedish act.

The data obtained from the app were handled by a designated server that fulfils the same requirements as for electronic health records. The data were sent by wireless technology from the older persons' smartphones or tablets to the server. To ensure confidentiality, a PIN code was needed to log in by the older persons and the homecare nurses.

The coded questionnaires, audio files, transcribed interviews, focus group transcripts, and the transcribed logged data have been encoded and locked in a separate fireproof cabinet separate from the code list; all of which are only accessible by the researcher of this project. All the logged data were sent from the company to the researcher of this project by email that required a specific log in password in order to gain access.

All data have been presented on a group level to prevent identification of the older persons. The citations chosen in the publications were presented in a manner that would not lead to the identity of the older persons.

The project obtained ethical approval from the Uppsala Regional Ethical Review Board (reg.no 2012/357) and (reg.no 2011-09).

## Results

The presentation of the results will be divided into the headings: The older persons' perspectives of health and self-care (study I), followed by The older persons' and the nurses' experiences of the app (studies II-IV), The older persons' and the nurses' use of the app (study IV) and The older persons' aspects of health (study IV).

### **The older persons' perspectives of health and self-care**

The data from the scoping review and the interviews with healthcare experts, older persons and nursing assistants appeared to agree; see Table 2. The results revealed that from the perspectives of the older persons, there were four areas perceived to be of importance to their health and self-care; 'frame of mind', 'having relationships and social activities', 'physical ability and concerns' and 'maintaining self-care' (study I).

Table 2. Overview of the studies' contribution to the identified areas

Reference	Frame of mind	Having relationships and social activities	Physical ability and concerns	Maintaining self-care
Bowling et al. 2006	X	X	X	
Bryant et al. 2001	X	X	X	
Carpenter 2002		X	X	
Ceria-Ulep et al. 2011			X	
Chan et al. 2006	X		X	
Cott & Tierney 2013				X
Dale et al. 2012				X
Fusco et al. 2012			X	
Gallacher et al. 2013	X			
Gruenewald et al. 2007		X		
Gruenewald et al. 2009		X		
Gruenewald et al. 2012		X		
Heslin et al. 2001			X	
Loeb 2006				X
Reyes-Gibby et al. 2002			X	
Thomas et al. 2004			X	
Tsai & Tsai 2007				X
Tse et al. 2012			X	
Wilhelmson et al. 2005	X	X	X	
Yang & Chiou 2012			X	

### Frame of mind

From the three data sources (literature, interviews with healthcare experts, and the interviews with older persons and the nursing assistants) were descriptions of how having a positive attitude was important for health. The literature highlighted examples of having willpower and having internal control such as taking charge over one's own life as being important.

The older persons expressed the importance of having something to look forward to. The healthcare professionals (the healthcare experts and nursing assistants) described the value of the older persons having time to reflect.

The literature and the healthcare professionals described depression as an obstacle to perceived health. Feelings like anxiety or being afraid were also seen as obstacles for health according to the healthcare professionals.

### **Having relationships and social activities**

The literature showed the importance of the family's role in the older persons' health. The older persons highlighted it even more when they discussed how the contact with their family was a vital part of their perceived health. In the literature, as well as with older persons and healthcare professionals, relationships were described as being important to perceived health. From the literature, the relationship was described as being useful to others, and the older persons mentioned how crucial it was to have a good relationship with their family, children and friends.

Furthermore, all three sources mentioned how having different and meaningful social activities were important to perceived health. Being involved in society was described in a variety of ways in the literature and from the different sources. The healthcare professionals described physical activities, hobbies and traveling as means to be involved in society, while the older persons gave examples such as listening to the radio or reading.

### **Physical ability and concerns**

From the three sources, physical ability was described as essential for health. The difference was that the literature described physical disabilities as being related to anxiety and depression. The older persons instead emphasised that their perceived health was affected by their physical ability in that it could alter their independence, for example being able to eat on their own. Likewise, the healthcare professionals brought up how being able to physically perform tasks without assistance impacts one's experience of health.

Physical concerns such as pain and sleeping problems were described by all three of the aforementioned sources as obstacles to health. Older persons also cited constipation. Healthcare professionals reported that being tired could be an obstacle to health.

### **Maintaining self-care**

In the literature, the description of self-care had more variation than in the other areas e.g., being able to perform activities of daily living (ADL) and being involved in activities that minimise health deterioration. Moreover, to be motivated to adopt changes due to health, to seek information on how to handle health concerns and to contact healthcare professionals for support were described as self-care activities.

Self-care was described by the older persons as learning about the normal ageing process and having the information and knowledge needed to improve health.

The nursing assistants expressed self-care as a way of being able to sustain ADLs. The healthcare experts highlighted the need for knowledge, but in more medical terms such as specific diseases and how to handle various symptoms.

### **The older persons' and the nurses' experiences of the app**

Among the older persons included ( $N=17$ ), were 11 women and 6 men with a mean age of 86 years (range 70-101). All lived alone, except for one older person who lived with a spouse. Two thirds of the older persons had a junior compulsory school education. They had diverse chronic conditions and health problems such as cardiovascular illness and respiratory disorders, see Table 3.

Table 3. Participants' sociodemographic and medical characteristics

Variables	(N=17)
Age, years, mean (SD)	86 (6.5)
Females, n (%)	11 (64.7)
<i>Marital status, n (%)</i>	
Married/living with partner	1 (5.8)
Living alone	16 (94.1)
<i>Education, n (%)</i>	
Junior compulsory	11 (64.7)
Senior high school	1 (5.8)
College/university	4 (23.5)
Other education	1 (5.8)
<i>Chronic conditions, n (%)</i>	
Cardiovascular	15 (88.2)
Musculoskeletal	9 (52.9)
Respiratory	4 (23.5)

SD = standard deviation.

The older persons' and homecare nurses' experiences of using the app (study II) resulted in the overarching theme 'creating participatory care by using an app', which was based on five sub-themes, 'an enabler for learning', 'a new way of communication', 'a sense of security and maintaining safety', 'increased self-confidence' and 'challenges in using new technology'. The older persons described a new form of self-care support and a sense of security during the interviews directly after the intervention (studies II and III). However, they reported a decrease in sense of security and self-care ability at the 6-month follow up (study III). The use of the app showed a significant improvement in the older persons' communicative and critical health literacy at the 6-month follow-up (study IV).

### **Enable learning via the app and health literacy**

Learning new technology and being able to report health concerns in a new way was described by the older persons as stimulating (study II). With time and their interest to learn, they managed the procedure (study II).

The older persons' functional health literacy showed to be unchanged over the three assessment points, and no differences between the three times were found in the results, see Table 4. However, their communicative and critical health literacy showed a significant change over the three assessments points ( $p=0.012$ ). It was also significantly improved at the 6-

month follow-up compared to baseline ( $p=0.020$ ) and at the end of intervention ( $p=0.025$ ), see Table 4.

Table 4. The participants' ( $N=17$ ) levels of health literacy at baseline, at the end of intervention and at 6-month follow-up

Health literacy levels	Time points			P value <sup>a</sup>	P value <sup>b</sup>	P value <sup>c</sup>	P value <sup>d</sup>
	Baseline <i>n</i>	End of inter- ven- tion <i>n</i>	6- month follow-up <i>n</i>				
Swedish FHL, <i>n</i>				1.000 <sup>†</sup>	0.739 <sup>†</sup>	0.480 <sup>†</sup>	0.779 <sup>°</sup>
Sufficient	5	3	4				
Problematic	9	13	7				
Inadequate	3	1	4				
Missing	0	0	2				
Swedish C & CHL, <i>n</i>				0.257 <sup>†</sup>	0.020 <sup>†</sup>	0.025 <sup>†</sup>	0.012 <sup>°</sup>
Sufficient	2	3	8				
Problematic	9	9	3				
Inadequate	5	3	3				
Missing	1	2	3				

FHL = Functional Health Literacy; C & C HL = Communicative and Critical Health Literacy.

<sup>a</sup> Baseline vs end of intervention, <sup>b</sup> Baseline vs 6-month follow-up, <sup>c</sup> End of intervention vs 6- month follow-up, <sup>d</sup> Comparison over all three assessment points

<sup>†</sup> Wilcoxon signed rank test, <sup>°</sup> Friedmans test

### The older persons' sense of security

The older persons' interactions with the homecare nurses via the app were perceived by the older persons to increase their sense of security. They gave examples such as when they struggled with a hearing impairment, the app made it easier to contact and report health concerns to the homecare nurses, which created a sense of security (study II). The app was also seen as something that could give answers, which instilled a sense of security (study III).

For those living alone or when their only outside contact was the homecare nurse, the reporting could improve their sense of security (studies II and III). The app, according to the older persons, gave them the opportunity to receive face-to-face visits by the homecare nurses when their health concerns deteriorated, which strengthened their sense of security (study III). With the reporting, the homecare nurses received more

knowledge about the older persons and their health, which was reassuring for the older persons and gave them a sense of security (study III).

The reporting increased the older persons' sense of security, because if they did not send a scheduled report, the homecare nurses were supposed to check with the older person and find out why (study II). Knowing that when a severe health concern was reported and an automatic alert will be generated, also instilled a sense of security for the older persons (study II). They also described how their sense of security increased with the app as it could be used as a complement to their ordinary personal safety alarm (study III).

The results indicated that there was a significant difference in the older persons' sense of security across the three assessments times, see Table 5. Despite the aforementioned experiences of an increased sense of security, a Wilcoxon signed rank test showed a significant decrease in the assessment at the 6-month follow-up compared to the one directly after the intervention, (study III), see Table 5.

Table 5. The older persons' (N=17) sense of security at baseline, end of intervention and at 6-month follow-up

Instrument	Time		
	Baseline - end of interven- tion	Baseline - 6-month follow- up	End of intervention - 6-month follow-up
Sense of security	(n=17) z= -1,406 p= 0.160 <sup>b</sup>	(n=16) z=-1,539 p=0.124 <sup>b</sup>	(n=16) z=-2,292 p=0.022 <sup>b*</sup>
			p=0.031 <sup>a*</sup>

The significance level was 0.05.

a Friedmans test was used. b Wilcoxon signed rank test was used.

\*p <0.05.

The homecare nurses referred to the app as a safety aspect, since they received updated information from the older persons if their health status declined or was unaltered. Moreover, the homecare nurses described how they gained more knowledge about the older persons that they were not previously aware of (study II).

### Increased self-confidence for the older persons

The older persons expressed increased self-confidence when they felt they had mastered the smartphone/tablet and the functions in the app (study

II). This was further described as being modern, updated with the new technology in society, and being part of the future. Conducting the reporting created a feeling of being recognised and of being important, despite their old age.

Their self-confidence was also supported by the self-care advice, as the older persons' prior knowledge was strengthened. They were encouraged to seek, with or without support from family, more health information on the webpages (studies II and III).

The homecare nurses had also noticed the increased self-confidence in the older persons and mentioned how they had grown as individuals by being able to handle the smartphone/tablet and app (study II).

### **The older persons' self-care ability**

The older persons described the self-care advice in the app as a means to conduct self-care activities instead of having to contact the homecare nurse (studies II and III). Moreover, having direct accessibility to the webpages was valued and described as self-care (study II). The content of the self-care advice was considered appropriate and the knowledge they gained stimulated them to search for more information (study III). From a few of the older persons, there were suggestions that the self-care advice could be more individual and related to specific conditions or health concerns (studies II and III). The use of the self-care advice varied among the older persons from only knowing it existed to being supported by it (study III).

The score for the Appraisal of Self-Care Agency scale was the highest at baseline (Md=88), but then decreased at the end of intervention (Md=84) and again at the 6-month follow-up (Md=81). The results of the Friedman's test showed no significant changes in the older persons' self-care ability over the three assessment times, see Table 6. However, a Wilcoxon signed rank test revealed a significant decrease in their self-care ability at the 6-month follow-up compared to baseline, see Table 6.

Table 6. The older persons' ( $N=17$ ) ASA-A Scale at baseline, end of intervention and at 6-month follow-up

Instrument	Time			
	Baseline - end of intervention	Baseline - 6-month follow-up	End of intervention- 6-month follow-up	
ASA-A scale	( $n=13$ ) $z=-0,892$ $p=0.373^b$	( $n=14$ ) $z=-2,343$ $p=0.019^{b*}$	( $n=11$ ) $z=-1,785$ $p=0.074^b$	$p=0.281^a$

The significance level was 0.05.

a Friedmans test was used. b Wilcoxon signed rank test was used.

\* $p < 0.05$ .

### **New way of communication and a challenge to use the app**

In the beginning, learning how to use the smartphone/tablet, i.e. how to log in, and how to use the different functions in the app was expressed as an obstacle for some of the older persons and that caused anxiety (study II). The older persons described how the nurses could follow the reported health concerns as well as receive alerts (study II). The older persons were able to suggest improvements for the contents in the app e.g., expanding some of the response alternatives because of their increased knowledge and experience regarding the app (study II).

The homecare nurses mentioned how the older persons were able to be more precise with the reports, instead of just stating they felt unwell and thereby could participate more (study II). They perceived the alerts as relevant and an easy way of communicating, although the workload increased because of the alerts and the need to follow up on the reported health concerns. It was suggested that receiving alerts was sufficient, and that it was not necessary to log in every day (study II).

### **The older persons' and nurses' use of the app**

Results of the logged data (study IV) showed a high use of the app, median 96% (range 3-100%) among the older persons ( $N=17$ ). They sent in 383 reports during the three-month intervention. In total, 1 253 health concerns were reported by the older persons, and all of the health concerns included in the app were used, see Table 7. Difficulties performing personal activities and activities with others were the most commonly

reported health concerns, which were followed by pain and fatigue. For the distribution of frequency and distress levels for the health concerns, see Table 7.

Table 7. Participants ( $N=17$ ) reported health concerns by occurrence, frequency and distress level

Health concerns	Occurrence $n$ (%)	Frequency		Distress	
		Median	Range	Median	Range
Difficulties performing personal activities ( $n=17$ )	262 (20.9)	3 (2-3)	1-4	2 (2-3)	1-4
Difficulties performing activities with others ( $n=17$ )	252 (20.1)	3 (2-3)	1-4	2 (2-3)	1-4
Pain ( $n=13$ )	221(17.6)	3 (3-4)	1-4	3 (2-3)	1-4
Fatigue ( $n=14$ )	190 (15.1)	3 (2-4)	1-4	2,5 (2-3)	1-4
Insomnia/sleeping difficulties ( $n=11$ )	87 (6.9)	3 (2-3)	1-4	2 (2-3)	1-4
Dizziness ( $n=8$ )	71 (5.6)	2 (2-3)	1-4	2 (2-3)	1-4
Worry ( $n=9$ )	50 (3.9)	2 (2-3)	1-4	2 (2)	1-4
Depressed/Sadness ( $n=11$ )	49 (3.9)	2 (2)	1-4	2 (2)	1-4
Diarrhoea ( $n=7$ )	34 (2.7)	2 (2-3)	1-4	2 (2)	1-4
Constipation ( $n=4$ )	14 (1.1)	2 (2)	1-4	2 (2)	1-4
Loss of appetite ( $n=6$ )	12 (0.9)	3 (2-4)	1-4	2 (2)	1-4
Difficulties eating ( $n=5$ )	6 (0.4)	1 (1-2)	1-4	1,5 (1-2)	1-4
Fever ( $n=4$ )	5 (0.4)	2 (1-2)	1-4	2 (1-2)	1-4
Total	1 253				

Frequency 1= almost never, 2= sometimes, 3= often, 4= almost always  
 Distress levels 1= not at all, 2= a little, 3= pretty much, 4= very much  
 $Q_1$  = first quartile;  $Q_3$  = third quartile

Furthermore, 79 reported health concerns generated alerts to the homecare nurse, see Table 8. The two types of alerts consisted of the less severe ( $n=74$ ) yellow alerts and the severe ( $n=5$ ) red alerts. Pain was the most common yellow alert ( $n=33$ ), followed by dizziness ( $n=20$ ) and diarrhoea ( $n=14$ ). The most common red alerts were dizziness ( $n=3$ ) and diarrhoea ( $n=2$ ). Fourteen of the older persons' reports generated alerts, with 1 to 16 alerts per person.

Table 8. Distribution and category of the alerts linked to health reports by the participants ( $N=14$ ) during the intervention

Health concerns	Yellow alerts $n$ (%)	Red alerts $n$ (%)
Pain ( $n=9$ )	33 (44.5)	
Dizziness ( $n=4$ )	20 (27.0)	3 (60.0)
Diarrhoea ( $n=3$ )	14 (18.9)	2 (40.0)
Fever three days ( $n=2$ )	2 (2.7)	
Depressed/Sadness two days ( $n=1$ )	1 (1.3)	
Difficulties eating ( $n=1$ )	1 (1.3)	
Fever ( $n=1$ )	1 (1.3)	
Constipation ( $n=1$ )	1 (1.3)	
Diarrhoea and fever ( $n=1$ )	1 (1.3)	
Total alerts	74	5

Yellow alert; the homecare nurses contacted the participant within 24 hours.

Red alert; the homecare nurses contacted the participant the same day.

The homecare nurses had standardised notes regarding what form of contact was made regarding the alerts. They were for example, ‘contact with the patient’, ‘contact with physician’, ‘home visits’ and ‘telephone contact’.

For four out of the five red alerts, there were notes such as ‘contact with the patient’, ‘home visit’ or ‘no action, alert probably due to incorrect key being pushed’. For the 74 yellow alerts there were notes made for 35 of them, such as ‘home visit’, ‘no action’, ‘contact the patient’, ‘telephone contact’, ‘booked visit with patient’, ‘tried to reach patient no answer’, ‘patient has contact with physiotherapist’, ‘information received no action taken’, and ‘is sorted out, nothing new’. When the first alert came in regarding a health concern, the homecare nurses made the most notes, but when subsequent alerts for the same health concern came in, a note of ‘no action’ was often written as it was nothing new. There were 39 alerts that did not have notes made by the homecare nurses. Of those, 19 alerts were from two older persons that had sent the same alerts previously. The homecare nurses had made notes in the beginning, but quit doing so when the same concerns were repeated. For distribution of the notes, see Table 9.

Table 9. Notes made by the homecare nurses when receiving alerts from the participants ( $N=14$ )

Notes	Yellow alerts	Red alerts
	<i>n</i>	<i>n</i>
Home visits	10	1
No action	10	
Contact the patient	6	2
Telephone contact	4	
Booked visit with the patient	1	
Tried to reach patient- no answer	1	
Patient has contact with physiotherapist	1	
Information received no action taken	1	
Is sorted out, nothing new	1	
No action; alert probably due to participant pressing the wrong key		1
No notes made	39	1
Total	74	5

Yellow alert the homecare nurses contacted the participant within 24 hours.  
 Red alert; the homecare nurses contacted the participant the same day.

### **The older persons' aspects of health**

The older persons' aspects of health were consistent over the three assessment points. Their sense of coherence scores showed a small, but non-significant increase at the end of intervention. Their general health remained unchanged over the three assessments points. The older persons had a moderate risk for undernutrition from the baseline to 6-month follow-up. The results indicated no suspected depression at any of the three assessments points (study IV), see Table 10.

Table 10. Comparison of the median scores for the included instruments at baseline, at the end of intervention and at 6-month follow-up (N=17)

Instruments	Range	Median (Q <sub>1</sub> -Q <sub>3</sub> )			P value <sup>a</sup>	P value <sup>b</sup>	P value <sup>c</sup>	P value <sup>d</sup>
		Baseline	End of intervention	6-month follow-up				
SOC	13-91	63 <sup>γ</sup> (59-70)	66 <sup>β</sup> (59.7-74.5)	64 <sup>π</sup> (59-73)	0.084 <sup>!</sup>	0.754 <sup>!</sup>	0.073 <sup>!</sup>	0.113 <sup>°</sup>
HI	9-36	24 <sup>β</sup> (23-28.7)	24.5 <sup>β</sup> (21.2-28)	25 <sup>π</sup> (22-28)	0.506 <sup>!</sup>	0.061 <sup>!</sup>	0.170 <sup>!</sup>	0.338 <sup>°</sup>
NUFFE	0-30	6 <sup>γ</sup> (4-9.5)	8 <sup>γ</sup> (4.5-9.5)	7 <sup>π</sup> (5-9)	0.301 <sup>!</sup>	0.524 <sup>!</sup>	0.136 <sup>!</sup>	0.651 <sup>°</sup>
GDS	0-20	3 <sup>ε</sup> (2.2-5.5)	5 <sup>π</sup> (2-9)	5 <sup>π</sup> (4-8)	0.125 <sup>α</sup>	0.219 <sup>α</sup>	1.000 <sup>α</sup>	0.156 <sup>∞</sup>

GDS = Geriatric Depression Scale; HI = Health Index; NUFFE = Nutritional Form for the Elderly; SOC = Sense of Coherence scale. Q<sub>1</sub> = first quartile; Q<sub>3</sub> = third quartile;

<sup>a</sup>Baseline vs end of the intervention; <sup>b</sup>Baseline vs 6-month follow-up; <sup>c</sup>End of the intervention vs 6-month follow-up; <sup>d</sup>Comparison over the three assessment points.

<sup>!</sup>Wilcoxon signed rank test; <sup>°</sup>Friedman's test; <sup>α</sup>Friedman's test; <sup>∞</sup>Cochran's Q-test; <sup>α</sup>McNemar's test.

<sup>γ</sup>n=17; <sup>β</sup>n=16; <sup>π</sup>n=15; <sup>ε</sup>n=12.

## Discussion

The results demonstrate that a sense of security can increase for older persons receiving home care when using an app for reporting of health concerns. With the use of the self-care advice in the app, self-confidence increased among those older persons. The results also showed that with support of an app their health literacy improved in terms of seeking and applying information to improve their health. The older persons' high use of the app demonstrated that it could be implemented as a tool in conventional home care.

Results from the studies are discussed below under the subheadings: The older persons' sense of security, Support of self-care via an app for older persons, Improved health literacy among older persons and Implementation of the app in home care.

### Results discussion

#### The older persons' sense of security

The older persons described an increased sense of security when using the different components included in the app (studies II and III). For instance, they mentioned the feeling of comfort they acquired with the direct connection regarding the health concerns, the alerts to the homecare nurses, and the belief that the nurses would check if reports were not being made. The results are in line with studies using other versions of the app for persons with prostate or pancreatic cancer, which also showed an increased sense of security (Gustavell et al., 2018; Hälleberg-Nyman et al., 2017; Langius-Eklöf et al., 2017; Sundberg et al., 2015).

A sense of security is rather similar to being reassured. This is in accordance with studies conducted in a variety of populations and settings, i.e. persons with heart problems (Seto et al., 2012), chronic obstructive pulmonary disease (COPD) (Williams, Price, Hardinge, Tarassenko, & Farmer, 2014), and chronic heart and respiratory conditions (Halcomb, Purcell, Hickman, & Smyth, 2016). In other studies for specific conditions such as COPD, diabetes and cardiovascular disease, being reassured was a less prominent factor (Kim & Lee, 2017; Whitehead & Seaton, 2016).

In reference to their experience of using the app and sense of security, most of the older persons explicitly used the Swedish term 'trygghet', which conveys a feeling of comfort (studies II and III). Sense of security is

one of six ‘senses’ (sense of continuity, of belonging, of purpose, fulfilment and significance) that has been found to be essential to improve care for older persons (Nolan, Davies, & Grant, 2001). However, when describing a sense of security it can also include a feeling of safety, i.e. free from harm and threat (Nolan et al., 2001). This shows how a sense of security, ‘trygghet’ in Swedish, is a Scandinavian concept for which there is no English equivalent that fully captures the nuance implied (Tøien, Bjørk, & Fagerström, 2017). Moreover, the Scandinavian sense of security seems to have more of a focus on the feeling of being comforted and trusted instead of on the safety aspect of being protected (Tøien et al., 2017). An additional reason that the older persons highlighted a sense of security can be that during their lifetimes, society’s development in Sweden has had a major focus on welfare and sense of security (Andersson, 1984). In Sweden a sense of security is a political aim that is addressed in the laws (SFS 2001:453, 2001; SFS 2014:821, 2014), and ‘trygghet’ is stated to be the basis for care and welfare.

Another reason for the older persons’ increased sense of security may be that almost all of the older persons lived alone. They mentioned how the app was an additional way to communicate with the homecare nurses and that it could be used as a complement to their personal safety alarm (study III). In contrast, the use of a personal safety alarm has been described by older persons living in their own homes as something that has not increased their sense of security (Boström, Bravell, Lundgren, & Björklund, 2013). Approximately one third of the older persons in Sweden are living alone (Statistic Sweden, 2014) and the proportion of older persons living alone is increasing worldwide (World Health Organization, 2002). In Japan the development of new technology to maintain safety for older persons living alone is steadily increasing (Obi, Ishmatova, & Iwasaki, 2013). To increase security is also in line with the framework active ageing, which highlights the older persons’ right to feel secure (World Health Organization, 2002).

The decreased sense of security at the 6-month follow-up (study III) may be explained by the fact that the older persons missed having the new way of interacting with the homecare nurses. Studies show that the increasing use of mobile phones among older persons is because of the different functions, which enhance their sense of security (Parker, Jessel, Richardson, & Reid, 2013) as well as their ability to contact healthcare professionals (Nguyen, Irizarry, Garrett, & Downing, 2015). Considering that interaction is essential for participation (Eldh et al., 2010), the older

persons' decreased sense of security indicates that new innovative tools such as an app, might be helpful from the older persons' perspective.

I suggest that it is crucial to have the concept of sense of security as a foundation when implementing an app as a tool in home care for older persons.

### **Support of self-care via an app for older persons**

Self-care needs were identified in the literature, but not to the same extent as by the older persons (study I). One reason for this can be that some of the interviewed older persons (study I) received regular self-care support from healthcare professionals, and therefore they did not think of it as something they would perform themselves. Even though the older persons wanted to participate in their self-care, the nurses' attitudes to hand over self-care activities could have played a role in how self-care was perceived by the older persons (Sahlsten et al., 2008). Additionally, the experience that an older person's health is deteriorating can interfere with the desire to participate in their care (Angel & Norup Frederiksen, 2015; Lyttle & Ryan, 2010).

The results show that the use of the self-care advice led to increased self-confidence (study II), and it supported their self-care (study III). The results concur with studies reporting that self-care can be supported (Buck et al., 2017) and also increased (Guo & Albright, 2017) after receiving information. The possible explanation for the increased self-confidence is that the included self-care advice was provided according to the gerontechnology perspective, which highlights facilitation of the older persons' learning to improve their health by means of digital tools (McCallum et al., 2017). Another reason could be that the access to the self-care advice inspired them and made them more aware as well as more active in the management of their self-care (Eldh et al., 2010; Sahlsten et al., 2008; Þórarinsdóttir & Kristjánsson, 2014). Self-care can be viewed as a life-long learning process, and it is important to keep updated regarding one's health with the use of new technology in advanced age (Brink, 2017; World Health Organization, 2002).

The decreased self-care ability at the 6-month follow-up (study III) might be due to an awareness of the opportunity the app created, and the fact that the older persons missed having the ability the app created to be more active in their own care after the completion of the intervention. The reason for the decline may be that they could no longer actively seek ad-

vice themselves. Instead they had to rely on the homecare nurses contacting them and the nurses' knowledge and initiative, which may have led to a perceived passivity in self-care (LeBlanc & Jacelon, 2018) and also a feeling of dependency (Høy et al., 2007). Another possible reason could be a decreased opportunity to access appropriate information (Thórarinsdóttir & Kristjánsson, 2014). To support self-care has been highlighted as an important factor in order to promote health and independence for older persons as long as possible (McCallum et al., 2017; World Health Organization, 2002).

### **Improved health literacy among older persons**

The improved communicative and critical health literacy among the older persons at the 6-month follow-up (study IV) might be an effect of the intervention. The reason for this improvement might be due to their feeling encouraged after using the app and that the included information targeted older persons. For example, it has been described that when the information is adapted to the older persons' situation, the likelihood the information will be used is increased (World Health Organization, 2015a). The included self-care advice may have inspired some of the older persons to seek more information and strengthen their own resources (Høy et al., 2007) as well as their prior knowledge (Eldh et al., 2010; Thórarinsdóttir & Kristjánsson, 2014). Their improved interest to gain information and apply it (study IV) concurs with the previous results where the older persons described how important seeking and receiving information and knowledge was to their being involved in their care (study I). Health literacy is shown to decline with older age (Kruse et al., 2017) and learning to use new technology can be a challenge for older persons, even though they are interested in learning about their health (Boulton-Lewis, 2010).

### **Implementation of the app in home care**

The homecare nurses' perspectives

The homecare nurses experiences of the older persons use of the app and their own experiences of using it were mostly positive (study II). However, the homecare nurses' attitudes towards the technology varied. This could be because some of them used older mobile phones that lacked the technology for reading the alerts. This led to an increased workload because

they had to go to the workplace computers to read them (study II). Registered nurses working in home care have described a more neutral view of using the digital technology as a complement for interaction with persons, since they prefer face-to-face contact (Fagerström, Tuveesson, Axelsson, & Nilsson, 2017). The reason might be because they perceived barriers in the system and prefer a more compatible, easy to use mHealth system (Gagnon, Ngangue, Payne-Gagnon, & Desmartis, 2016).

The app developed for this project needs to be seen in consideration of the rapidly evolving context of digitalisation, i.e. ICT, mHealth and apps. With the continuous development, it is essential to implement feasible and meaningful mHealth innovations into the context of home care. According to the developers of digitalisation, mHealth and government recommendations, there are benefits to be found in health care with the use of this technology in the near future that can promote health and decrease inequality in health care (European Commission, 2012; Governments and Swedish association of local authorities and regions, 2016). Although, it is stated that the technology in healthcare systems should be seen as a complement to face-to-face contacts (Varshney, 2014), I consider it critical that the goal should not be just the use of mHealth as a tool in home care. Instead, mHealth should have the goal to meet the needs of those receiving home care and working in it. Home care should combine the best from face-to-face encounters and technology.

### The older persons' perspectives

The older persons' high use of the app (study IV) indicates that the app was seen as a convenient tool. The explanation might be that they found the included components easy to use. Easy to use apps for reporting health problems can have a positive effect on persons' involvement in health care (Sawesi, Rashrash, Phalakornkule, Carpenter, & Jones, 2016). Furthermore, for some older persons, the high usage might mirror their interest in using new technologies as well as their participation in the development of technology in society, which is in accordance with the cornerstones of health and participation in active ageing (World Health Organization, 2002). The increasing use of smartphones by older persons (Oh et al., 2018) and the inclusion of them in the use of this technology in all kinds of settings is of interest worldwide (Henriquez-Camacho, Losa, Miranda, & Cheyne, 2014; Hoque & Sorwar, 2017). Therefore, it is important to include older persons in the development phases (Mort et al., 2015) of the

emerging technology and to develop support systems in health care adapted to them, and for their use (Melchiorre et al., 2018).

The high use of the app (study IV) and suggestions for minor improvements of the app's functionality (study II) shows that the older persons can and will become more active partners in their care, and they want to be included in the development of new technology such as mHealth innovations. One probable explanation is that the older persons felt they were 'seen' and involved with the use of the app, as well as having a feeling of being respected and taken seriously (Thórarinsdóttir & Kristjánsson, 2014). This is in line with requests to include older persons and their values, to co-create, when developing new innovations in order to increase their acceptability (World Health Organization, 2013). The concept of co-creation is also highlighted in person-centred care as a basis in the relationship between the person, the family and healthcare professionals (Ekman, Hedman, Swedberg, & Wallengren, 2015). It has also been recognised that more studies are needed that also include persons living at home and receiving support from healthcare services as well as persons with different experiences in order to co-create knowledge (Greenhalgh, Jackson, Shaw, & Janamian, 2016; Wolf et al., 2016). The aim of co-creation is to exchange diverse perspectives and to share different experiences (Andersson, Rosenqvist, & Ashrafi, 2007). The interaction leads to the persons becoming more actively involved in health care (Lally & Tullo, 2012). They also contribute with input, ideas and perspectives regarding processes that have not been clearly highlighted before (Gallan, Jarvis, Brown, & Bitner, 2013).

## **Methodological discussion**

### **Design**

To meet the overall aim different designs were employed. The use of a qualitative descriptive design (study I) was chosen in order to identify and describe health concerns and self-care from the older persons' perspectives. The descriptive design was employed because the phenomenon might not be sufficiently studied from the population's perspective previously (Brink & Wood, 1998). Using a descriptive design together with an inductive approach ensured the capturing of the older persons' perspectives. With this approach, a deeper knowledge regarding health and self-care was obtained. The explorative design (study II) ensured that the older persons'

and the homecare nurses' experiences of using the app were taken in account. With an explorative design the attempt was to explain a phenomenon or process (Brink & Wood, 1998). As there are limited results on older persons and homecare nurses use of mHealth, an exploratory design was considered appropriate (Brink & Wood, 1998).

The quasi-experimental design was applied to describe and evaluate the older persons' self-care support and sense of security (study III), their use of the app, impacts on aspects of their health, and their health literacy (study IV). One strength of the quasi-experimental design is the natural setting in which the intervention is conducted, one that is also more representative of the daily practices found in nursing (Brink & Wood, 1998). Moreover, with the questionnaire at baseline, at the end of the intervention and at the 6-month follow-up (studies III and IV), the evaluation of the intervention was secured (Polit & Tatano Beck, 2017). Quasi-experimental design can also include a control group (Brink & Wood, 1998). However, for the current intervention a control group was not possible because of the homecare context and the difficulty in enrolling a sufficient number of older persons. The benefit of a control group is that the effect of the independent variable, i.e. the intervention is better supported (Polit & Tatano Beck, 2017). Other factors than the intervention could have had an impact on the results, and without a control group there is no way to make a comparison (Brink & Wood, 1998). However, according to MRC's framework, which was followed, it can be necessary to apply a quasi-experimental design to the population when a randomised design is not applicable due to a difficulty enrolling participants (Craig et al., 2008). Using a historical comparison group, i.e. collecting data before the intervention (Polit & Tatano Beck, 2017), may have been an alternative, but it was not practical to apply this method in this context because of the lack of eligible older persons. However, the use of a historical comparison group has limitations, because during the different time periods a variety of confounders could interfere with the results (Polit & Tatano Beck, 2017).

### **Sample and setting**

The inclusion criteria, older persons that were cognitively able, led to the exclusion of some older persons. However, as the use of the app required an ability to learn and remember instructions, the inclusion criterion, of being cognitively able, was considered appropriate. It is well-known that

problems with memory can be common in old age (Enkvist et al., 2012). The use of the app also demanded that the participants could read and understand Swedish; this resulted in the exclusion of the older persons that lacked that ability. These conditions might result in a selective sample and therefore possibly limit the transferability of the results (Polit & Tatano Beck, 2017).

The older persons included in the intervention (studies II-IV) were identified by the homecare nurses, which may have positively and negatively impacted the participation. One cannot be sure that the homecare nurses assessed some of the older persons as too old, not being interested or unable to use this new technology. In addition, their own perceptions of using mHealth to communicate with older persons could have interfered with their assessment. Those perceptions may have had an influence on who the homecare nurses identified as eligible. For example, registered nurses have described concerns regarding the use of mHealth as a tool for the support of persons receiving primary care, because it might decrease personal contact as well as alter the control they have in their daily practice (Öberg et al., 2018).

The procedure might also have been influenced by the trust the older persons had in the homecare nurses, and therefore they agreed to participate. The older persons may also have found it difficult to decline as they received home care from the homecare nurses.

These different aspects of bias can be a weakness of dependability and a threat to internal validity (Polit & Tatano Beck, 2017) that need to be taken into consideration with the small sample and when interpreting the results.

The reasons some of the older persons declined were health problems or lack of experience with smartphones or tablets (studies II-IV). If older persons with multiple health problems had been reporting, another diversity in the results might have been shown, i.e. in the health concerns in the logged data, their self-care ability, their sense of security, their aspects of health and their health literacy. If additional older persons with a lack of experience and interest in mHealth had participated, the results may have been impacted. Furthermore, lacking confidence in their ability to learn and use the smartphone or tablet might also have played a role in their non-participation in the intervention, as self-confidence has been shown to be a reason for not using the technology (Siren & Knudsen, 2017). If a greater number of older persons with a lower interest in the technology had chosen to participate, there might have been more of them that con-

sidered it more of a learning experience and the challenge to use the app had been more emphasised, than was described (study II). However, the older persons that participated in the intervention did not have much experience in using smartphones or tablets. Therefore, the representativeness of the sample might not totally mirror the older persons receiving home care, and that could impact the results and should be taken into account.

The non-participants can possibly be explained by the aforementioned reasons and they put limitations on the evaluation of the intervention's impact (studies III-IV). This resulted also in a small sample (studies III-IV), but the same problem is described in interventions among persons with heart failure receiving support via mHealth (Athilingam & Jenkins, 2018). The small sample size resulted in an increased risk for a type II error, but it does not exclude the results having a clinical significance (Polit & Tatano Beck, 2017). On the other hand, starting a complex intervention with a small study is suggested in order to prepare for larger evaluations (Craig et al., 2008; Richards & Rahm Hallberg, 2015).

In all, the results from these studies (studies II-IV) do not represent the entire older population receiving home care and the results have to be generalised with caution (studies III-IV). Despite that, with a thorough description (studies II-III), the transferability can be assessed (Lincoln & Guba, 1985; Polit & Tatano Beck, 2017). Moreover, the home care is well-described (studies II-IV), but there can be a limitation in the transferability of the results to similar samples and settings in other countries that do not have the same kind of healthcare system that Sweden has.

## **Interviews and instruments**

The interviews with the healthcare experts were conducted either by telephone, by email or face-to-face (study I), and this may have interfered with the extent and richness of the data. If all of the interviews had been conducted face-to-face, there might have been more extended explanations and it might have been easier for the researcher to pose probing questions face-to-face. On the other hand, with telephone interviews it can be easier to relax and express one's opinion (Novick, 2008). Since the interviews did not involve personal matters and the interviews were rather short, it can be appropriate to conduct them by telephone (Polit & Tatano Beck, 2017). It can also be appropriate to conduct interviews by telephone when geographical distance is an issue (Kvale & Brinkmann, 2009). The use of

these different ways can be viewed as strengthening the dependability (Polit & Tatano Beck, 2017).

The choice to use individual interviews with the older persons at the end of the intervention (studies II-IV) was made in order to capture their recent experiences. Furthermore, during the interviews the smartphone or tablet and the app were sometimes needed to facilitate an understanding of how the older persons had used it. Using this procedure the obstacle of memory loss can be minimised, which can pose a problem when using new technology with persons of advanced age (Mayhorn et al., 2017).

The use of different ways of collecting data, i.e. interviews with the older persons and a questionnaire at the three assessments points (studies II-III), could have contributed to a more complete understanding and strengthened the credibility of the data (Polit & Tatano Beck, 2017). Using only the study specific question regarding sense of security and the ASA-A scale (Söderhamn et al., 1996a) might have limited the understanding of the older persons' use of the app. The older persons' highlighted experiences of sense of security and self-care had not been explored to the same extent if the interviews (studies II-III) had not been conducted.

The Swedish C & C HL Scale (Wångdahl & Mårtensson, 2014) and the Swedish FHL Scale (Wångdahl & Mårtensson, 2015), which were included (study IV) have been tested in older populations (Svanholm, 2016; Yoshida, Iwasa, Kumagai, Suzuki, & Yoshida, 2014). The limitations are that they have not been tested in a context of home care nor with follow-ups. Furthermore, the contents in the Swedish C & C HL Scale and the Swedish FHL Scale have their focus on one's health literacy and are less concerned with the technology used while searching for it. An instrument with more of a focus on health literacy and technology may have achieved other results, but when the intervention took place, a Swedish version did not exist. This deficit may have impacted the results of the intervention, so therefore they should be interpreted with some caution. It can also be doubtful how changeable functional health literacy is over a short period, as was the case for this intervention.

The use of so many instruments can be questionable, as it can be burdensome for the older persons to complete them all. However, with the paper version of the questionnaire it might be that the older persons had time to reflect over the included items and their responses. Furthermore, they received help from the researcher to fill in the questionnaire if needed.

## **Analysis**

The author of this thesis discussed and reflected on the preunderstanding during the research process with the research group that had varied experiences and perspectives. This procedure minimises the influence of preunderstanding when conducting data collection or data analysis and might also support reflective thinking (Lincoln & Guba, 1985). The different data analyses employed (studies I-IV) depended on the data quality and were thoroughly discussed within the research group. The discussions could therefore ensure the credibility and dependability of the data collection as well as the data analysis (Polit & Tatano Beck, 2017).

The different steps included in the analyses (studies I-IV) were thoroughly described and discussed by the researchers. The preliminary results were also discussed by the researchers until a consensus was reached (studies I-III). The process strengthened the credibility and dependability (studies I-III), and it minimised the threat to the validity (studies III-IV) (Polit & Tatano Beck, 2017).

The chosen quotations represented a variety of the participants' descriptions and experiences, both the positive and the negative (studies I- III), in order to illustrate the results. The researchers discussed the quotations accuracy in depicting the data during the process. This approach ensures that the quotations represent the data and minimises the impact of the researchers preunderstanding, and thereby strengthens confirmability (Lincoln & Guba, 1985).

## Conclusions

The results from this project indicate that the use of an interactive app, based on the older persons' perspectives of health and self-care, can be implemented as a tool in conventional home care for some older persons living in their own homes. The older persons most likely to use this app are those that live alone, that have few contacts outside their home and that do not have too complex health problems. The new way to communicate and interact with homecare nurses can encourage the older persons to take the initiative to be active and participate more in their own care.

The use of the app and its components can increase the older persons' sense of security. The awareness that there could be a new way to communicate with the homecare nurses resulted in a decrease in their sense of security at the 6-month follow-up. This indicates that the use of an app as a tool needs to be considered for some of the older persons receiving home care.

Self-care was not considered to be of major importance for some older persons. However, with the support via an app, that includes self-care advice and links for further reading, self-confidence and self-care ability can be increased. The possibility that the older persons missed having the app, resulted in the decrease in their self-care ability after the intervention was completed.

The older persons improved their ability to critically analyse and apply information related to their own health. This could be due to the reinforcement they received with the use of the app and the included self-care advice and links for further reading. This is of importance since there is evidence that health literacy declines with old age. With the help of new technology such as mHealth, it is possible to support lifelong learning for some older persons.

The older persons' aspects of health remained unchanged, which could be a result of the limited intervention time and/or the small sample size. Therefore, there is a need to employ larger studies to evaluate the use of the app and its impact on older persons' aspects of health.

The high use of the app during the three-month intervention by the older persons indicates that the app is feasible to use in home care and the contents are relevant. Some of the older persons were so inspired by the use of the app that they gave suggestions for future minor improvements. This is of importance with the rapid digitalisation of health care and home care. It is also important with the healthcare systems aim to provide equal care to all.

To meet the needs of older persons living in their own homes and receiving home care, there is a need for the further development of mHealth. This development needs to be based on the older persons' preferences and in co-creation with them, in order to support their participation in their own care and self-care.

## Implications

Innovations in home care are needed due to the increasing proportion of older persons in the population as well as the demands on the healthcare system. The use of mHealth can be one way to meet this need. The results from this project indicate that for some older persons receiving home care, an interactive app can be implemented as a tool in conventional home care.

There is a further need to identify the older persons receiving home care who will gain support with the use of the app. When developing mHealth and the app, there is a need to consider more input from older persons in the process.

There needs to be more focus on ways to stimulate learning and increase a sense of security as well as enable access to self-care advice among older persons receiving home care. One possibility, in light of the rapid digitalisation, is to have municipalities offer tablets to those who are interested. This approach will also help maintain equality in health care, which includes home care services.

Homecare nurses should have good introduction to mHealth to be able to enhance the support this technology is intended to provide the older persons using the technology. The municipalities, which are responsible for home care, might need to provide further education and training in mHealth for the nurses. Furthermore, it is essential that nurses are also included in the early development phases of mHealth innovations so their preferences and needs in daily practice are met.

## Further research

Future studies need a larger sample and longer follow-up than this project had, to evaluate older persons' self-care ability and health literacy when using an app as a tool. A larger sample and longer intervention time are also needed to evaluate the impact using an app has on aspects of health. Additionally, a randomised control study would make it possible to evaluate and compare the use of an app with e.g. regular home visits and telephone contact. Other interventions could be conducted with the aim to explore as well as evaluate the homecare nurses' daily practices using mHealth, such as an app to manage the older persons' health concerns.

Nursing research needs to conduct more studies with interventions that are designed to support self-care, health and participation in care by means of an app used among older persons receiving home care. There is a need for more interventions designed together with older persons. Further studies are needed with the older persons' perspectives of using this technology as well as their utilisation of care.

Further qualitative research with descriptive design studies are needed to acquire a deeper understanding of which older persons receiving home care will gain support using this kind of app. To improve the self-care support given with the use of an app by older persons receiving home care, studies are needed to describe self-care from their perspectives.

## Summary in Swedish

### *Bakgrund*

Den ökande andelen äldre personer i befolkningen samt att fler lever längre är en global utmaning. Samtidigt kan längre livslängd ses som ett resultat av förbättringar i samhället över tid. Dock ökar risken för hälsoproblem med stigande ålder och därför är det angeläget att fokusera på att bibehålla äldre personers hälsa så länge som möjligt. Begreppen hälsosamt åldrande och aktivt åldrande belyser olika aspekter av åldrande och inkluderar exempelvis delaktighet, hälsa och rättigheter för äldre personer. Hälsa är beskrivet både som ett tillstånd men också som en förmåga att uppnå eller att bibehålla sin hälsa. Med stigande ålder, speciellt bland personer över 80 år eller äldre kan olika hälsoproblem uppkomma, exempelvis depression, hörselnedsättning och nedsatt fysisk förmåga. Behovet av hemsjukvård ökar också med anledning av detta samt att majoriteten önskar bo kvar i egen bostad. För att bibehålla hälsa hos äldre personer och att kunna hantera hälsoproblem framhålls att det är betydelsefullt att stödja äldre personers egenvårdsförmåga. Äldre personers egenvårdsförmåga kan påverkas av deras fysiska och mentala kapacitet, egna resurser samt också deras hälsolitteracitet som kan beskrivas som förmågan att förstå och använda information för att bibehålla sin hälsa.

Geronteknologi har blivit ett angeläget område det vill säga att utifrån de äldres perspektiv utveckla teknik inom olika forskningsområden, för att de äldre ska kunna bibehålla hälsa, sitt oberoende och kunna bo kvar så länge som möjligt i sitt hem. Samtidigt har digitaliseringen inom hälso- och sjukvården ökat, exempelvis mHälsa som inbegriper att inhämta, överföra och övervaka data via mobiltelefoner och surfplattor mellan personer och hälso- och sjukvårdspersonal. Det är beskrivet i studier att huvudsakligen personer med diabetes, kroniskt obstruktiv lungsjukdom och hjärtbesvär är de som använder och rapporterar hälsoproblem via denna teknologi. Egenvårdsråd är också ofta inkluderande i studier med mHälsa. Få äldre personer, över 65 år, är dock inkluderade i studierna och det finns inte många studier med äldre personer som har hemsjukvård. För att främja personer att bli mer aktiva i sin vård har en interaktiv app utvecklats för smarta telefoner och surfplattor. Det är ett interaktivt system som inkluderar följande komponenter: äldre personer rapporterar förekomsten av hälsobesvär, frekvensen och hur besvärande hälsobesvären är, rapporten skickas via en säker server till distriktsköterskornas arbetsdatorer, vid försämring i hälsobesvären får distriktsköterskorna larm till sina arbets-

mobiler och kontaktar de äldre personerna. I appen finns tillgång till egenvårdsråd med tillhörande länkar för vidare information. De äldre personer kan följa de rapporterade hälsobesvärerna via appen och distriktsköterskorna via deras arbetsdatorer.

Med anledning av de äldre personernas ökande andel av befolkningen är det angeläget att utveckla mHälsa som motsvarar de äldre personernas behov och förväntningar för att hantera hälsobesvär och stärka egenvårdsförmågan. Tidigare forskning har påvisat att äldre personer är inkluderade i begränsad utsträckning vid användandet av mHälsa och särskilt när de har hemsjukvård.

### *Övergripande syfte*

Det övergripande syftet för projektet var att utveckla och utvärdera en interaktiv app med äldre personer som har hemsjukvård.

### *Metod*

Delstudierna i projektet följde de olika stegen om hur komplexa interventioner genomförs inom hälso- och sjukvården, utvecklat av Medical Research Council. Första steget är att beskriva och förstå problemet och sammanhanget, därefter utveckla interventionen för att sedan beskriva och optimera interventionen inför utvärdering i större studier. Både kvalitativ och kvantitativ design har använts i delstudierna. Deskriptiv design användes i studie I för att identifiera och utforska hälsa och egenvård från de äldre personernas perspektiv för att bli inkluderat i appen (studie I). En utforskande design användes för att utforska de äldre personernas och distriktsköterskornas erfarenheter av att använda appen (studie II). I de två följande studierna användes en kvasi-experimentell design för att beskriva och utvärdera de äldres stöd för egenvård och trygghet (studie III) samt för att beskriva deras användande av appen och utvärdera hur användningen påverkade hälsoaspekter och hälsolitteracitet över tid (studie IV).

Studie I inkluderade en scoping review med artiklar ( $n=20$ ), intervjuer med hälso- och sjukvårdsexperter ( $n=5$ ), äldre personer ( $n=8$ ) och undersköterskor ( $n=7$ ). Intervjuerna med hälso- och sjukvårdsexperterna belyste vad som är viktigt för att uppleva hälsa och egenvård för äldre personer. Intervjuer med de äldre personerna och undersköterskorna innehöll data om de äldres upplevelse av hälsa i det dagliga livet. Data från intervjuerna

och artiklarna analyserades med kvalitativ innehållsanalys utifrån ett induktivt förhållningssätt.

Utvecklingen av den interaktiva appens innehåll baserades på resultat från studie I och en tidigare genomförd studie där appens innehåll testades. Resultaten låg till grund för utformningen av 13 frågor för hälsobesvär, egenvårdsråd med tillhörande länkar för vidare information. Det utarbetades ett automatiskt larmsystem, där hälsobesvärerna triggade larm utifrån frekvens och hur besvärande de var, som sändes till distriktsköterskornas mobiler, samt både de äldre personerna och distriktsköterskorna kunde följa de rapporterade hälsobesvär via en graf.

I studie II-IV identifierade sjuksköterskorna 76 äldre personer som uppfyllde inklusionskriterierna; 65 år och äldre, boende i eget boende, har hemsjukvård och har kognitiv förmåga att delta. Av dessa, skickade 51 in kontaktuppgifter och 32 hembesök genomfördes för introduktion av appen. Totalt startade 24 äldre personer och 17 slutförde interventionen. Alla ansvariga och berörda distriktsköterskor ( $n=12$ ) för de äldre personerna var inkluderade i interventionen.

De äldre fick låna en surfplatta eller mobil av forskarna med appen installerad. De äldre personerna informerades om att rapportera två gånger i veckan på veckodagar. De fick även information om hur appen fungerade, larmfunktionen, egenvårdsråden och grafen. De äldre kunde skicka ett extra SMS i samband med att deras rapportering initierade ett larm.

Frågeformuläret som delades ut vid start, vid avslut av interventionen och vid 6 månaders uppföljningen bestod av följande instrument; egenvårdsförmåga (Appraisal for Self-care Assessment Scale), risk för depression (Geriatric Depression Scale), generell hälsa (Hälsoindex) kostsituation (Nutritional Form for Elderly), känsla av sammanhang (SOC), förstå hälsosoinformation (Funktionell hälsolitteracitet), använda hälsosoinformation (Kommunikativ och kritisk hälsolitteracitet) och upplevelse av trygghet (en studiespecifik fråga).

Den loggade data som analyserades bestod av de äldres inskickade rapporter, frekvens och omfattning av hälsobesvärerna, antal larm samt distriktsköterskornas notering vid larm.

För att analysera de äldre personernas och distriktsköterskornas erfarenheter av att använda appen (studie II) användes tematisk analys. I studie III användes direkt kvalitativ innehållsanalys med förutbestämda koder. Deskriptiv och analyserande statistik användes för analys av data i studierna III och IV. Icke parametriska tester användes för att jämföra över de tre tillfällena och jämförelse mellan de olika tillfällena.

## *Resultat*

Data från litteratur och intervjuer i studie I resulterade i fyra kategorier; sinnesstämning, ha relationer och sociala aktiviteter, fysisk förmåga och besvär samt bibehålla egenvård vilket utgjorde underlaget för utvecklingen av innehållet i appen. De äldre personernas erfarenheter av att använda appen och distriktsköterskornas erfarenheter beskrevs såsom; en möjliggörare för lärande, ett nytt sätt att kommunicera, en känsla av trygghet och att bibehålla säkerhet, ökat självförtroende samt en utmaning i att använda ny teknologi (studie II). I studie III framkom att de äldres upplevelse av trygghet ökade och att de upplevde stöd för egenvård i och med användandet av appen. Dock rapporterade de äldre en signifikant minskning vid 6 månaders uppföljningen av trygghet och egenvårdsförmåga (studie III). Användandet av appen var hög bland de äldre personerna (studie IV). Det vanligaste hälsobesväret var smärta som genererade larm till distriktsjuksköterskorna. Distriktsköterskorna gjorde noteringar i cirka hälften av larmen. De äldre personernas kommunikativa och kritiska hälsolitteracitet visade en signifikant ökning vid 6 månaders uppföljningen. De äldre personernas olika hälsoaspekter förblev oförändrad över tid.

## *Sammanfattning*

Studierna visar att en app kan användas inom hemsjukvården som ett komplement för kommunikation mellan äldre personer och sjuksköterskor. De äldre personerna beskrev användningen av appen som en ökad trygghet och som ett stöd för egenvård, som saknades när de inte längre hade tillgång till appens funktioner efter interventionens slut. Användandet av appen kunde även stärka de äldre personernas självförtroende, och ökade deras medvetenhet att via andra forum söka och använda hälsoinformation. Den korta interventionstiden kan ha medfört att deras hälsoaspekter förblev oförändrade.

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