

SYMPOSIUM PRESENTATION 3: PHYSICAL AND MENTAL HEALTH

Health technology innovations

R. F. L. Azevedo (Convener)

Participants: H. Kort (Netherlands), J. K. Lee (USA), Y.S. Hwang (South Korea/Slovenia), G. Mois (USA). **ISSUE** The global pandemic has drastically impacted older adults in numerous ways (e.g., loneliness; age discrimination; mental and physical health; limited access to traditional health care). On the other hand, it may have accelerated the general acceptance of innovative health technology solutions to cope with many of these challenges. Providing the best possible care for older patients is reliant on having accurate information, and mobile health (known as mHealth) solutions and online services have taken on increasing prominence. Furthermore, the innovations in socially assistive robotics grant advantages in providing healthcare services because robots can interact closely with users, for example allowing both verbal and non-verbal interactions with reduced risks of human-to-human infections. **CONTENT** Interdisciplinary efforts are required to develop successful health technology to support a broad range of needs to enhance quality and healthy aging-in-place. The symposium will showcase research efforts and emerging technologies ranging from mHealth applications, online interventions, and socially assistive robots to support healthy aging. These innovations are capable of track movement, sleep quality, medications, blood pressure, heart rate, air quality, and other signifiers. Older adults, family members, and healthcare providers can use these solutions to help identify emerging issues, and tailor care strategies to individual needs. **STRUCTURE** First, Helianthe S. M. Kort will present a study that investigates sleep patterns, air quality and sleep quality of older adults using a smartphone app. This study explores possible workable interventions to provide older people a better sleep by using technology innovations. Jeannie Lee will present a digital therapeutic system (a smartphone app and companion website) to support hypertension medication adherence for older adults. Yu Seong Hwang will present a study that investigates the effects of socially assistive robots to support older adults with chronic obstructive pulmonary disease. Lastly, George Mois will describe a project that explores the potential of a socially assistive robot to support healthy aging. The goal is to understand the robots' ability to facilitate social interactions with older adults, and support the control of their home environment and healthy aging-in-place. Each presentation will be followed by time for questions to engage the audience in the discussion of health technology innovations to support healthy aging-in-place. **CONCLUSIONS/OUTCOMES** The global pandemic greatly accelerated the relevance of health technology innovative solutions, both in establishing new approaches and solutions to care in general, and in advancing the many trends that were already gaining ground over the past decades. The goal of the symposium is to (a) increase awareness of the development and use of a broad range of innovative health technology interventions to support healthy aging; (b) engage researchers in discussion that might lead to future collaborations; (c) set the research agenda to improve quality of life for older adults who are aging-in-place; and (d) explore how mHealth, online interventions, and socially assistive robots solutions may help older adults requiring different supports to healthy aging.

Keywords: aging-in-place, innovative health technology, mobile health applications (mHealth), socially assistive robot

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Exploring the effects of indoor air quality on sleep and sleep quality of older people

H. S. M. Kort, M. G. L. C. Loomans

Purpose We all are familiar with the phenomenon that when having a bad night's sleep we feel lousy the next day. This is also the case for people with dementia. We received a cry for help from a family carer claiming that his spouse with dementia displayed agitation and other symptoms of Behavioral and Psychological Symptoms of Dementia (BPSD) after a bad night while being exposed to poor indoor air. Nurses and family caregivers do report that some BPSD problems occur when heaters/air-conditioners are not switched on sufficiently early enough to maintain a comfortable indoor thermal environment (Wong et al., 2014). In a case study by Cremers (2015) findings showed that restlessness behavior (apnea, panic, humming) is observed in a person with dementia during the night when CO₂ levels in the bedroom exceed 800 ppm. Poor indoor air quality (IAQ), measured via carbon dioxide (CO₂) as a proxy, has a negative effect on people's health and performance (Wyon & Wargocki, 2013; Allen et al., 2016). Furthermore, it is known that bedroom air quality relates to sleep quality and next-day performance in healthy young adults (Strøm-Tejsen et al., 2015). Little is known though about the influence of indoor air quality on persons with dementia. To explore this, we first wanted to reproduce the study of Strøm-Tejsen, before moving to involve ageing people because of ethical and practical reasons. **Method** Therefore 3 studies (single case-cross-over) were executed involving 40 participants. The first study involved 18 healthy adults < 30 years, the second 10 ageing adults between 30 and 55 years, and the third study 12 older people > 55 years. All participated voluntarily after signing informed consent. Participants were healthy and were instructed to not use any medication, drinks, or food that might influence their sleep one week before and during the experiments. Participants were randomized to one of the two conditions, namely open or closed windows (study 1) or controlled mechanical ventilation with Low Ventilation (LV 15m³/h) or High Ventilation (HV 91m³/h) (study 1 and 2). Measurements in one condition were during 1 week. After 1 week of rest, participants were assigned to the other condition. Sleep parameters such as Sleep latency, Length of sleep, No. of awakenings, and sleep efficiency were measured objectively via actigraphy. For that, participants wore a Sensewear armband on the upper right arm. For sleep quality, the same parameters were measured subjectively including Sleep Depth using The Groningen Sleep Quality Scale (GSQS), and the Pittsburgh Sleep Quality Index (PSQI) that rates sleep over longer periods, and by filling in a sleep diary. The indoor environment was measured by continuously measuring relative humidity (%), air temperature (°C), and CO₂ concentration (ppm). Background noise (dB) was an interval measurement. The studies were executed in the Netherlands during the winter season to limit the possible influence of (day) light. Detailed information can be found in Mishra et al., 2018 and van der Veen et al., 2021. **Results and Discussion** The study of Strøm-Tejsen et al. could be reproduced. For ageing people < 30 years, sleep quality (sleep depth/sleep phase) worsens due to a reduction in bedroom ventilation. The CO₂ concentration went from 717 ppm (open) to 1150 ppm (closed). In bedrooms of people aged 30 - 55 years sleep quality (length of sleep, sleep latency) worsens due to a reduction in the bedroom ventilation (CO₂ levels were 680 ppm (HV) to 1007ppm (LV)). In bedrooms of people, 55+ CO₂ concentrations went from 1007ppm (HV) to 1409 pp (LV). When comparing the people in study 2 with study 3, the number of awakenings was significantly higher in subjects 55+ ($p = .003$) while the depth of sleep was significantly lower for them ($p = .019$).

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SYMPOSIUM PRESENTATION 3: PHYSICAL AND MENTAL HEALTH

A technology innovation to improve hypertension medication adherence for older adults

J. K. Lee, K. C. Insel, J. S. Nicholas, R. F. L. Azevedo, W. A. Rogers

Purpose Hypertension medications are highly effective in controlling blood pressure and preventing deleterious effects on the heart, kidneys, eyes, and brain (Wing and Gabb, 2018; Benetos et al., 2019). However, adherence to hypertension medications is low at only around 50%, and nonadherence leads to decreased quality of life and increased healthcare costs - \$290 billion/year in the United States (Osterberg and Blaschke, 2005; NEHI 2009). Technology innovations can improve medication adherence, and an increasing number of older adults are using smartphones - 81% for 60-69 years, 62% for ≥ 70 years (Kakulla 2020). We have developed a digital therapeutic system (a smartphone app and companion website) to support hypertension medication adherence for older adults. **Method** An interdisciplinary team of clinical, cognitive aging, gerontechnology, human factors, and health technology experts across multiple institutions collaborated to develop the Medication Education, Decision Support, Reminding, and Monitoring (MEDSReM[®]) system. A theory-based and previously tested prospective memory intervention for older adults (Insel et al., 2016) was used as a base for the technology translation into MEDSReM[®] (Al-Saleh, 2022). Our interdisciplinary team developed and conducted human factors evaluations of every component of the system, including the educational materials, decision support algorithms, reminder options, blood pressure integration, and feedback visualizations. **Results and Discussion** MEDSReM[®] is a theory-based, older user-centered, and integrated digital therapeutic system that educates, supports missed dose decisions, reminds, monitors hypertension medication adherence, and incorporates blood pressure feedback. The MEDSReM[®] system is being tested among older adults who use hypertension medications in a randomized clinical trial. Well-designed technology intervention developed by interdisciplinary teams with complementary expertise and tested with older adults may improve adherence to hypertension medications that can lead to improved health outcomes.

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Socially assistive robot-based alerts on indoor and outdoor air-quality for patients with chronic obstructive pulmonary disease

Y. S. Hwang, H. S. Jo, W. J. Kim, S. Sin

Purpose Socially assistive robots (SARs) are utilized to help older adults requiring cognitive support such as affective therapy, cognitive training, and social-skill enhancement (Feil-Seifer & Mataric., 2005). In addition, the SAR has advantages in providing home-based healthcare services since it can become intimate with its users, allow verbal and non-verbal interactions, and enable timely monitoring (Abdi, Al-Hindawi, Ng & Vizcaychipi, 2018). Meanwhile, poor IAQ (Indoor air quality) can adversely affect health and thus require IAQ management (WHO, 2010). The elderly with chronic obstructive pulmonary disease (COPD) spends more time indoors, so they are affected by the indoor air quality (IAQ) and require the management of IAQ. Therefore, we developed a SAR platform by networking the IAQ sensor, weather open API, conversation engine, and SAR to provide air quality alerts and support patients in activities that can improve or maintain IAQ. We evaluated whether the ability to management of older adults is improved through IAQ alerts. Additionally, we provided personalized instructions on inhaler usage and confirmed whether clinical indicators were improved. **Method** We conducted an unblinded, single group, observational pilot test and assessed the feasibility of the IoT-based SAR system. Sixteen patients with COPD (n=16) participated in the study. The pilot study persisted for 16 weeks. For 8 weeks in the first phase, participants utilized a SAR with an IAQ sensor. During the 8 weeks of the second phase, voice message alerts concerning inhaler use were played by SAR. **Results and Discussion** Results from machine learning indicate that the SAR platform can assist older adults to control IAQ by giving alerts. And, the alerts may improve the capability of older adults to maintain IAQ. In addition, after receiving the instructions on inhaler use, adherence to inhaler usage (TAI) was significantly improved ($z=-1.98$, $P=0.048$), and the breathlessness scale was significantly decreased ($z=-2.112$, $P=0.035$). The results present empirical evidence that SAR integrated with environmental alarm systems is helpful in the behavioral change of the patients. We do believe that our findings could provide a basis for systems integrating SAR and IoT in healthcare fields.

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SYMPOSIUM PRESENTATION 3: PHYSICAL AND MENTAL HEALTH

Understanding the application of socially assistive robots in the home to support healthy aging

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Purpose: The number of adults entering older adulthood is increasing across the world, with many communities often lacking the resources and services need to meet their needs. The result of these gaps in resources and services are creating significant challenges for healthy aging, overall quality of life, and ability to age in place. Aging-in-place is defined as “one’s journey to maintain independence in one’s place of residence as well as to participate in one’s community” (Rogers et al., 2020). However, technologies such as socially assistive robots hold much potential in expanding the access to resources, which may help enhance quality of life, promote healthy aging, and support aging-in-place. Assistive robots can support health and psychological wellbeing, and serve as personal assistants (Flanderfer, 2012). However, there is limited understanding regarding the application of market-ready socially assistive robots to support healthy aging in the context of a home environment. More specifically, the health application of socially assistive robots to enhance older adults’ ability to age-in-place and their quality of life is not well-defined. Our research explores the capability of a customizable, market-ready socially assistive robot called Misty II, developed by Misty Robotics, to facilitate health applications to support older adults. **Method:** Our interdisciplinary team consisted of experts in design for aging, human factors, and engineering. We developed a curated a set of tasks that would be feasible for Misty II to convey to older adults. These tasks included conversational assistance (e.g., weather forecast, check-in on how the day is going), support with controlling a home environment (e.g. turning off the lights), and health reminders (e.g., medication schedule, doctor appointments). Although Misty II is commercially available robot, it requires programing expertise to facilitate complex human robot interactions. We programmed Misty to simulate the human-robot interaction to demonstrate to older adults how this type of robot might be used in a home environment. Given older adults’ limited experience with robots (Smarr et al., 2014), it is important to illustrate how such interactions might occur. To help display these potential applications we adapted and developed a set of videos which aim to provide an enhanced visual demonstration of the potential application of socially assistive robots. **Results and Discussion:** Understanding the role of socially assistive robots in the home to support healthy aging in an important component in enhancing the quality of life of older adults. Our efforts illustrate the need for interdisciplinary teams to develop the appropriate activities for commercial robots to support health activities. Furthermore, we identified essential considerations pertaining to application of socially assistive robots to support healthy aging. In the next phase of our research, we will identify facilitators and barriers for older adults’ acceptance and use of a socially assistive robot like Misty II to support healthy aging.

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