



Review article

Information technologies for active and assisted living—Influences to the quality of life of an ageing society



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ABSTRACT

Introduction and objectives: The current and upcoming demographic change in industrial countries is a challenge for our society, economically as well as socially. The aim of this article is to explore the influences of information and communication technologies applied to contribute to these trends and describe its impact to the quality of life and subjective health of elderly.

Methods: In a structured literature review on (a) scientific publications and (b) outcome reports of ambient assisted living projects, we investigated these associations. The results are summarized according to the multidimensional approach of quality of life considering the bio-psycho-social model of health. The project outcomes of current initiatives are consolidated and recommendations for future research in the field of active and assisted living were issued.

Results: Current research efforts show that assistive information and communication technologies can successfully contribute to all dimensions of elderly's quality of life. As example technologies can empower them to control their health problems, compensate functional disabilities and increase their safety. Otherwise, remote-communication could lead to reduced face-to-face communication and social exclusion.

Conclusion: More research using adequate methods: and instruments is needed to demonstrate the identified effects and to deliver evidence of the impact to the life of the heterogeneous population group of elderly.

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1. Introduction

The World Health Organisation (WHO) identified the demographic change as one of the biggest challenges for the society in the western countries [1]. This trend is also intensively discussed by the European Commission who reported that the ageing population in its member states will have a tremendous impact on productivity and economic growth in future [2]. The population part of the member states aged 65 years and above will increase from 17.4% in 2010–29.5% in 2060. This could lead to a doubling of the ratio of dependent elderly (aged 65 years and above relative to aged 15–64) [3]. The ageing population will put pressure on the social care and health care systems and will lead to a reduced availability of care staff in the affected areas. To deal with these challenges information and communication technologies (ICT) and assistive technologies will play an important role to help people stay healthy and live independently at home for a longer time [1].

Within the European Commissions' action plan 'Ageing Well in the Information Society' a program called 'Ambient Assisted Living Joint Research Programme' (AALJP) was established that has the aim to develop appropriate ICT solutions. The technologies shall improve peoples' quality of life (QOL), increase health and enable them to live independently in their familiar environment as long as possible. The AALJP recently was prolonged within the research program Horizon 2020 under the term 'active and assisted living' (AAL) lasting from 2013 to 2020 [4].

The concept of ambient assisted living (respectively the new term 'active and assisted living') includes systems using ICT and socio-technical services in daily life and working environment to enable individuals to live an active, socially involved and independent life up to old age [5,6]. The range of these technologies include very sophisticated and quite simple ICT solutions like smart home systems, applications in the field of tele-health, reminder functions, fall detection systems, videophones, video game and a lot more. They all have in common that their objective is to improve the QOL of the recipient or user. The majority of available studies and project outcomes of AAL-solutions deal with technical aspects and feasibility engineering and do not provide sufficient data or evaluation outcomes of the impact to the users' QOL.

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This is why the aim of this review is to analyse possible impacts of ICT-components, typically used in AAL-solutions, to the health and QOL of elderly. Due to the integrating and comprehensive character of AAL-solutions the content partially overlaps what means that selected papers may be discussed in several sections. Furthermore the evidence of the AAL-related effects to the individuals' QOL was investigated by conducting a literature search of current AAL-projects. The pathways and associations between QOL and the impact of technology are reviewed and summarized according to the multidimensional model of QOL of the WHO [7]. Possible implications for further development and research in the field of ICT and AAL-solutions and QOL were discussed and recommendations issued.

In the field of health promotion ICT can play several roles in public health. It can be used as a medium of intervention (for behaviour change, e.g. smoking cessation or for the distribution of health information), as focus of research (seeking for health information), as a research instrument (electronic surveys), and for theoretical and conceptual issues (for professional development) [8]. In this review the character of different ICT solutions as a medium of intervention to influence the individuals' QOL is highlighted and investigated in more detail.

1.1. Definition of QOL

In health promotion and public policy decision making the construct of QOL is used as instrument for evaluation of intervention outcomes in clinical as well as non-clinical settings [9,10]. The WHO defines QOL as an *“individual's perception of his or her position in life in the context of the culture and value systems they are living and in relation to their goals, expectations, standards and concerns”*. This broad concept is affected by the *“physical health, psychological state, level of independence, social relationship and their relationship to salient features of their environment”* [7].

This definition implies that the process of ageing can affect one or more of the dimensions of the old person's subjective QOL. Most of the frequently used instruments for measurement of QOL-outcomes, e.g. the WHOQOL-BREF/100 [7,11] questionnaires, cover the physical, psychological, social and environmental domain that comply with George L. Engel's bio-psycho-social holistic approach of subjective health [12].

For aged people QOL is an important area of concern because it reflects their health status and well-being considering the vulnerable issues of their daily life [13]. It is crucial to understand which factors lead to their perceived life satisfaction and QOL according to the individuals' needs and limitations [14].

The main objective of this study was to identify influences of AAL-solutions to elderly's QOL and health and explain the pathways of these effects. Therefore first the contributions of ICT to

elderly's QOL were reviewed and QOL-outcomes of AAL-projects were analysed.

2. Methods

After initial literature search it became obvious that the QOL-related available literature in the field of AAL is very rare, heterogeneous and provides not enough information to conduct a systematic review on AAL-solutions. This is why we decided to conduct a narrative review based on a structured literature search on ICT-solutions usually used in AAL-systems and their impact to the QOL of elderly. Additionally, all relevant findings of QOL in AAL research were structured and summarized.

The electronic search including literature databases (from the year 1998 on) was carried out from March to December 2014. We considered following databases: The Cochrane Library, Cochrane Central Register of Controlled Trials, The Cochrane Database of Systematic Reviews, Pubmed, Web of Science, Medline, SCOPUS, EMBASE, OvidSP. For search terms and syntax see Table 1. The Journal of Gerontechnology [15], the resources of the ICT-PSP [16] and the AALJP-program [4] were searched manually for relevant information. Furthermore grey literature search was executed to identify studies, literature and project reports that are not indexed in the databases listed above, using search engine google scholar.

After removing the duplicates, the remaining articles were screened to its relevance to the research topic using following criteria:

1- Articles comprising outcomes of medical technologies used in intramural settings and interventions were excluded (e.g. laparoscopic technology, pacemaker and surgery technologies).

The abstracts of the remaining articles were searched for associations between technology and its impact to QOL or health. Technology-focussed articles with no relevance to the research topic were excluded.

1- Outcomes associated with QOL of current AAL-research were included

- The cited resources of the articles were searched for relevant information adding knowledge to the original article and new information was included

The remaining articles were thematically summarized to paragraphs according to the technical setting and areas of application. In this work the findings were separated into two thematic results sections: (a) ICT/AAL and QOL in scientific literature and (b) AAL and QOL in project reports.

The influences and possible impacts to the QOL-dimensions of the solutions are allocated to the domains of the WHOQOL-BREF [17] (physical, psychological, social, environmental) and summarized in tables. Moreover recommendations for future research, gathered during the review, are presented.

Table 1
Search Syntax for Structured Literature Search.

<p>(“QOL” OR “Quality of Life” OR “wellness” OR “wellbeing”) AND (“AAL” OR “Ambient Assisted Living” OR “Ambient Assisted Technology” OR “Ambient Assistive Technology”)</p>
<p>(“QOL” OR “Quality of Life” OR “wellness” OR “wellbeing”) AND (“ICT” OR “information and communication technology”) AND (“elderly” OR “aged” OR “senior” OR “senior” OR “Quality of Life” OR “wellness” OR “wellbeing”) AND (“telecommunications technology” OR “telecommunication technology”) AND (“elderly” OR “aged” OR “senior” OR “old”)</p>
<p>(“QOL” OR “Quality of Life” OR “wellness” OR “wellbeing”) AND (“eHealth” OR “e-health”) AND (“elderly” OR “aged” OR “senior” OR “homebound” OR “old”)</p>
<p>(“QOL” OR “Quality of Life” OR “wellness” OR “wellbeing”) AND (“technology” AND (“assistive” OR “assisted”)) AND (“elderly” OR “aged” OR “senior” OR “old”)</p>
<p>(“QOL” OR “Quality of Life” OR “wellness” OR “wellbeing”) AND (“Independent living” AND “technology”) AND (“elderly” OR “aged” OR “senior” OR “homebound” OR “old”)</p>
<p>(“QOL” OR “Quality of Life” OR “wellness” OR “wellbeing”) AND (“residential home” AND “technology”) AND (“elderly” OR “aged” OR “senior” OR “homebound” OR “old”)</p>
<p>(“QOL” OR “Quality of Life” OR “wellness” OR “wellbeing”) AND (“robotics” OR “robot”) NOT (“surgery” OR “rehabilitation” OR “laparoscopic”) AND (“elderly” OR “aged” OR “senior” OR “homebound”)</p>
<p>(“QOL” OR “Quality of Life” OR “wellness” OR “wellbeing”) AND (“smart home” OR “smart homes” OR “intelligent home”)</p>
<p>(“QOL” OR “Quality of Life” OR “wellness” OR “wellbeing”) AND (“gerontechnology” OR “gerontotechnology”)</p>
<p>“project” AND (“joint programme” OR “joint program” OR “ambient assisted living”)</p>

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