

VirtuALLProject in 6 Municipalities in the Center Region of Portugal: A Cross-sectional Study

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DOI: <https://doi.org/10.31577/SN.2023.3.22> © Ústav etnológie a sociálnej antropológie SAV, v. v. i.
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There is a growing interest in empowering older adults to age in place by different types of technology. In the last few years isolated programs with virtual reality, augmented and exergame was been developed in order to address the active and healthy ageing. The focus of this article is to analyse the influence of the VirtuALL project on 810 participants over 65 years old (76.5 ± 7.27 years; 76% female) from 6 Municipalities in the Center region of Portugal.

Findings revealed an improvement in digital skills, social interaction, physical and cognitive performance, suggesting that interventions that combine different technology with social innovation are assumed as an important strategy for the promotion of healthy aging and ageing in place, but additional research is needed to prove its effectiveness.

Key words: ageing, elderly, VirtuALL, cross-sectional studies

How to cite: Sousa, M., Cadima, T., Veríssimo, C., Assunção, M., Fidalgo, M. (2023). VirtuALL Project in 6 Municipalities in the Center Region of Portugal: A Cross-sectional Study. Slovenský národopis, 71(3), 227–243. DOI: <https://doi.org/10.31577/SN.2023.3.22>

Introduction

The improvements in life expectancy are one of the findings that best reflect the significantly transforming age structure and population dimension that have occurred over the last decades in Portugal. Population aging has been a trend

recorded in Portugal and also in Europe, according to data from the 2021 Census, 10 343 066 people live in Portugal (52% women and 48% men), from those 23.4% are people over 65 years old. Compared to 2011, this segment of the population increased by 20.6% (PORDATA, n.d.). The percentage of elderly people (over 65 years old) is higher in the Central Region with 27% and in the EU 27 where it is recorded at 40.90%. Also, according to the National Institute of Statistics (INE, 2019), 28.6% of the population that lives in the municipalities of Cantanhede, Figueira da Foz, Mealhada, Mira, Montemor-o-Velho and Penacova (Center of Portugal) are 65 years old or more.

Although the achievement of increased longevity is likened, it also implies the increase of the dependency ratios and of the social and health care costs (WHO – World Health Organization, 2020). The biopsychosocial perspective considers that the aging process is associated with various complex transformations, losses and limitations on different levels compared to other phases of the life cycle (Partridge, Deelen, Slagboom, 2018). People over 65 are more likely to have one or more health conditions, social exclusion, fragility, low self-esteem, incapacity, or disability (Wermelinger Ávila, Corrêa, Lucchetti, A. L. G., Lucchetti, G., 2022). In this sense, nowadays the Portuguese policy measures that accompany these demographic changes are not being very successful for the extension of a healthy life span (Santana, Sczygiel, 2014).

The diagnostic analysis of the area developed when preparing the 2014-2020 local development strategy of the Local Action Group, Bairrada and Mondego Local Development Association (AD ELO), showed an elderly population with low or no digital literacy, with physical limitations and little activity or participation, particularly those who are not institutionalized, and are still living in their houses, sometimes in isolated villages. In fact, statistics data shows that the majority of the Portuguese population (52.5%) completed the 1st cycle of basic education and, in the population over 65 years old, 12.4% have no education and only 6.5% completed secondary and post-secondary education (PORDATA, n.d.). Comparing to the EU 27, where the percentage of the population that does not have secondary education is 20.9%, this percentage is doubled in Portugal with 40.5% (PORDATA, n.d.).

These findings are in line with the literature, for example, at the level of literacy, Portugal is clearly below the average compared to other 16 European countries, including, among others, Spain, Italy, Denmark, France and Germany (Brandão, Ribeiro, Paúl, 2017). In the same sense, Mota-Pinto and colleagues (Mota-Pinto et al., 2011) concluded that illiteracy, as well as social isolation and undifferentiated occupation, are prevalent in Portuguese older population. In terms of physical activity, Marques and colleagues (Marques et al., 2014) indicate that fewer Portuguese older adults engage in moderate level physical activity/exercise compared to other countries where the rate of participation in moderate exercise is higher and also decline at a faster rate on all variables, that include functional fitness and anthropometric measures (Marques et al., 2014). In the same sense, according to Rodrigues and colleagues (2018), in their study, 66.6% of Portuguese older adults

were physically inactive. They also found some more interesting data, among individuals aged 65 and above, alcohol abstinence was high, but 33.8% reported daily alcohol intake, and most individuals (69.2%) reported never have smoked. As far as weight is considered, according to the profile of the Aging of the Portuguese Population study, overall, 43.3% of the analyzed population is overweight and 40.1% obese (Oliveira, Rosa, Mota-Pinto, Morais, Veríssimo, 2008). A worrying finding from the study across 17 European countries by Midão and colleagues (Midão et al., 2020) reveals that physical inactivity (such as quality of life and well-being) is also a predictor of polypharmacy. They found that Portugal is included in the list of countries where the prevalence of polypharmacy was the highest. Taking this population into account and its characteristics, particularly those who are still living in their houses, the literature also addresses the issue of falls. Almada and colleagues (Almada, Brochado, Portela, 2020) found that falls are prevalent in the European community-dwelling population and found some factors that were significantly associated with falls (e.g., age, female gender, polypharmacy and fear of falling, etc.). Considering Portugal, Silva and colleagues (Silva et al., 2019) demonstrated in their study that 60% of the participants reported fear of falling and 60% reported having had at least one fall in the last year. Given this context, it would be interesting to understand what perception elderly have about their health status. The study of the profile of the Aging of the Portuguese Population (Oliveira et al., 2008) revealed that 69% of the total respondents, especially the elderly women in the Central region of Portugal, indicated a negative self-assessment and/or the presence of health complaints and an unfavorable emotional state, through negative self-assessment and/or the presence of emotional complaints. Another study, in fact, showed that Portuguese older adults had frequent depression symptoms (11.8%) and these were higher in people aged around 80 (Rodrigues et al., 2018). These data seem to show a dark scenario; however, they can be seen effectively as new opportunities and open up space to think about educating these population and motivating behavioral change, planning and evaluating interventions. In fact, according to Rodrigues and colleagues (2018) the elderly population is a vulnerable group warranting dedicated intervention. In this sense, it is necessary to create intervention responses that can meet these opportunities. The literature also refers to this need, such as Mota-Pinto and colleagues (Mota-Pinto et al., 2011), who state that future research and fields of intervention should be attending to further determinants of isolation, adjust procedures to be included in social networks and develop actions directed to education, in order to influence the elderly quality of life.

As the purpose of giving an answer to these needs, the VirtuALL project was created, focusing on the opportunities given by social innovation and latest innovation technology. This project is developed by AD ELO in cooperation with the six municipalities mentioned above. The power in this project was to bring key actors (municipalities, universities, companies and the most important: the older adult) together around a common goal. Therefore, VirtuALL is an on-going project that assumes itself as a strategic and promising vision to face the current challenges of an

aging society. VirtuALL is based on the Green Paper on Healthy Ageing (EC – European Commission, 2021a) and addresses the European Principles of Social Rights (EC, 2021b), raising awareness and acceptance of the green and digital transition, particularly the Digital Decade Goals for digital skills (EC, n.d.).

VirtuALL is based on the values of human dignity, freedom, democracy, equality, and respect for human rights. This project is committed to making sure that technological solutions are fair, inclusive, and full of opportunities for everyone. We truly believe that everyone has the right to education, training and lifelong learning and should be able to acquire all basic and advanced digital skills. VirtuALL promotes equal access not excluding anyone based on sex, disability, race, ethnicity, religion, migration status, socioeconomic status, sexual orientation and gender identity. The digital tools/equipment plays a central role across the VirtuALL project and have a strong focus on inclusive and accessible technologies and training to be made available to all users (of all abilities). In fact, VirtuALL has minimal exclusion criteria and emphasizes people's abilities above their limitations. The main goal is to promote and develop an ecosystem that privileges the technology with the replication and the development of good practices in active and healthy aging, contributing to aging in place, fighting ageism and promoting health literacy and digital skills. Literature has demonstrated that technology can bring considerable benefits to this population. For example, Chaze and colleagues (Chaze et al., 2022) demonstrated that virtual reality shows potential to enhance the physical, emotional, cognitive, and social well-being of older adults. In the same sense, a study focusing on people in retirement in Europe aged 75 and older may greatly benefit from the use of VR and AR, that offer unique and innovative opportunities for them (Seifert, Schlomann, 2021). Also, exergames could be a contribution to the improvement of health and wellness of older adults and help them get physically active by promoting fun and enjoyment while exercising (Kappen, Mirza-Babaei, Nacke, 2019; Muñoz, Cameirão, Bermúdez i Badia, Rubio Gouveia, 2018). In this sense, more research is necessary to apply exergames as health and wellness interventions for older adults through physical activities.

VirtuALL project focuses on the potential of an aging world but also recognizes the challenges ahead. With humanistic approaches, we empower and motivate all older adults to live their full potential, promoting health and digital literacy that support the independence and daily functioning. It also allows them to promote their quality of life, increase social and intergenerational activities and a better adaptation to the green and digital transition of the 21st century.

So, VirtuALL is innovative in its area and in the region of implementation and makes it possible to create a unique and totally free ecosystem for the elderly. We offer different solutions for physical, cognitive, and social stimulation, technology and digital skills through different tools, techniques and equipment: PhysioSensing (a balance and pressure assessment platform with 2D games), PEPE – Portable Exergame for Elderly People (augmented reality gaming platform), Oculus Quest 2 (virtual reality equipment) and tablets. In the recent years, there have been significant advances in technologies to promote healthier aging, but many of those haven't been

separately analyzed. Studies have demonstrated the impact of virtual reality (Chaze et al., 2022), augmented reality gaming (Muñoz et al., 2018) and exergames (Kappen et al., 2019) to optimize older people's intrinsic capacity and functional ability (Seifert, Schlomann, 2021).

To the best of our knowledge, no studies describe the effects of the interventions that combine different types of technology with social innovation in Portuguese older adults that live in the community.

The aim of this study is to provide a profile of the sociodemographic and anthropometric characteristic of the participants, characterizing alcohol and smoking habits, mood, falls, physical activity and exercise, self-perceived health, and understand if the results of this sample are in line with those reported in the literature review. In addition, it pretends to explore the self-reported effects of this project in elderly community-dwelling from rural areas.

Material and Methods

Participants

Participants were selected from the VirtuALL project, established in a prospective study conducted by AD ELO, in the center region of Portugal. Data collection was conducted between October 2019 and December 2022.

Participants were recruited through community announcements in municipalities: Cantanhede, Figueira da Foz, Mealhada, Mira, Montemor-o-Velho and Penacova. The inclusion criteria were adults aged 65 or over, living in the municipalities referred to above and that want to participate in the present study. The exclusion criteria were (i) age less than or equal to 64 years old, (ii) presence of neurological or psychiatric disorder, (iii) chronic alcohol or drug abuse and (iv) inability to understand and cooperate.

Informed consent was obtained from all participants and the study received ethical approval from the local ethics committee. The study complied the tenets of the Declaration of Helsinki.

Procedures

VirtuALL aims to create and develop different products and activities, based on the best available scientific evidence and active participation methodologies, in order to train and empower older adults, through information and support for the adoption of a healthy lifestyle and promoting an active life in society. It materialized itself in the intervened territory in a decentralized way with a principle of approximation of the answers to the problems and with the development of different types of actions, totaling 675 sessions and 770 hours of duration. Overall, these sessions sought to provide elderly people with a unique experience of cognitive and physical challenges,

in individual and group formats, through technological solutions (including augmented reality, virtual reality, serious games in 2D/3D, among others). In this way, the sessions also promoted socialization and leisure for the elderly (thus counteracting the isolation that characterizes this population group). It should also be noted that the sessions were based on specific themes, thought to be important and appropriate for this public: digital and health literacy (stimulating the increase in health-protective and disease-prevention behaviors), promotion of physical activity, prevention of falls, participatory aging (promoting more active citizenship and social participation, through stimulating the reflective and critical abilities of participants), training and physical/cognitive activities in individual and group formats (using technological equipments, which brings together interactive applications and adaptable to the physical and psychological needs of the participants).

Various games and activities are explored in the equipments: in PEPE (Portable Exergame For Elderly People), the interaction of the elderly is planned, taking into account the specificities of the game and the person's characteristics at a motor and cognitive level, it is essentially ludic and cognitive and physically stimulating, allowing dual task in real time; in PhysioSensing is balance and plantar pressure equipment that allows baropodometry and stabilometry, in which evaluation protocols are carried out and other balance and stability training exercises and 2D/3D serious games are explored; with the Oculus Quest 2 (virtual reality), a varied set of cognitive stimulation games is used, promoting the dual task with feedback in real time, thus involving the participants in a unique and interactive experience; finally, tablets are explored in different ways, ensuring that the promotion of participants' digital and health literacy occurs in a playful and self-taught way, with the supervision of the technical team. The VirtuALL space, where the sessions take place, is dynamic, in which these various activities take place simultaneously and which the elderly experience alternately, providing them with different experiences and motivating their multisensory and immersive involvement.

Also, in the VirtuALL sessions, participants completed several questionnaires and tests. If they needed any assistance, a technician was available to help.

Sociodemographic characteristic includes age (calculated according to the year of birth), gender (male, female), years of education (illiterate, less than 4 years, 4 years, 6 years, 9 years, 12 years and higher education), number of medication and place of living (Cantanhede, Figueira da Foz, Mealhada, Mira, Montemor-o-Velho, Penacova or other).

For the collection of data about "Physical activity and exercise", "Use of digital technologies", "Smoking and drinking habits" and "Self-perceived health" we adapted Question 2, 3, 6 and 8 from the Lifestyle Assessment Toolkit 2.0, by HeaLIQs4Cities (Healthy Lifestyle Innovation Quarters for Cities and Citizens) (Reis et al., 2019). So, the "Physical activity and exercise" was assessed with the question: "Do you exercise regularly? No/Yes. If Yes: Walk/swimming or hydrogymnastic/Other". The variable "Use of digital technologies" was derived from the question: "Regular use of digital technologies (computer, e-mail, smartphone, social networks, etc.): Yes/No". The

“Smoking and drinking habits”, was a result of the sum of all answers of these questions: “Do you smoke regularly? Yes/No”; “Did you use to smoke regularly? Yes/No”; “When did you quit smoking? Options: <1 year ago/Up to 5 years ago/Up to 10 years ago/More than 10 years ago”; “Are you a regular consumer of alcohol (more than one glass of wine or beer with the meals)? Yes/No”; “Have you ever been a regular consumer of alcoholic drinks? Yes/No”. The variable Self-perceived health was assessed through the question: “In general, how do you evaluate your health condition? Options: Very good/Good/Fair/Bad/Very bad”.

The body-mass index (BMI) was calculated according to WHO criteria (WHO, 2000) and was categorized into six groups (underweight, < 18.5 kg/m²; normal, 18.5–24.99 kg/m²; overweight, 25.00–29.9 kg/m²; obese Class I, 30–34.99 kg/m²; obese Class II, 35.00–39.9 kg/m²; obese Class III, ≥40 kg/m²). Body weight and height were measured using a balance weighing scales and portable stadiometer.

European Portuguese version of the Falls Efficacy Scale-International (FES-I) (Figueiredo, Santos, 2017) is used to rate, on a four-point Likert scale, their concerns about the possibility of falling when performing 16 activities. The scores are added up to calculate a total score that ranges from 16 to 64 and a higher score indicates a greater fear of falling.

The variable “Fall in the last year” was rated by a question “In the last year, did you have a fall? Yes/No. If Yes: At home/Out of home”.

The top five reason why people fall was asked through an open response.

Timed Up & Go Test (TUG) (Steffen, Hacker, Mollinger, 2002) is used to access fall risk, following the respective correspondence of the validation studies for American population participants scoring. The participant was asked to rise from a standard armchair, walk to a marker 3 m away, turn, walk back, and sit down again.

The presence of depressive mood was evaluated using Geriatric Depression Scale (GDS) (Barreto, Leuschner, Santos, Sobral, 2007). A score < 10 in the GDS was used to consider the absence of depression symptoms.

The self-report of project VirtuALL evaluation was made in three different ways. First, a “Radar chart” (spider chart) was presented to participants with the following topic: balance, relation with technology, strength, eating habits, cognitive activity, happiness, social, physical activity. They answered in the first and last session of VirtuALL, using a scale from 0 to 10, where 0 means “bad” and 10 means “excellent”. Secondly, two questions are made to evaluate the VirtuALL project: “Has your interest in technology increased?” and “If you had the opportunity, would you like to continue using technology?” Please answer on a scale from 0 to 5, where 0 means “Strongly Disagree” and 5 “Strongly Agree”. Thirdly, participants were requested to write down if “Do you consider that VirtuALL project was important to you? Why?”.

Finally, for the evaluation of this project a continuous variable was also used, between 0 “completely dissatisfied”, 10 means “completely satisfied” and in the middle, 5, a neutral statement like “neither ‘satisfied’ or ‘dissatisfied’”.

Statistical Analysis

Exploratory descriptive statistics were performed in order to obtain the profile of the VirtuALL participants, for this reason these are presented as means with standard deviations for continuous variables and as percentages for categorical variables. For the open questions, transcripts were made anonymous, and all data was only used in this study.

Results

Table 1 shows the baseline characteristics of the participants.

From all 896 participants included in project VirtuALL, according to inclusion criteria we selected 810 participants with a mean age of 76.46, standard deviation (SD) of 7.28 years, range 65-103 years. Of these, 618 (76.3%) were female and 192 (23.7%) male. Most had completed only 4 years of education (52.5%) and a minority is illiterate (6.9%) or had higher education (3.8%).

Enrolled participants represented a geographically diverse population (rural/urban) and the majority lived in the municipality of Montemor-o-Velho (30%).

Based in WHO (2000) for the BMI, 43% is in the overweight category and 37% integrates the three categories of obese (Classes I, II, III), only 19% normal-weight.

A higher percentage (47%) were simultaneously on more than five medications and 42% of the participants have depressive symptoms. Almost all the participants did not have alcohol (2.2%) or smoking (0.3%) habits.

As reported in Table 1, the mean total score of the TUG was 11.91 ± 9.05 , suggesting that risk of fall is present in 42.5% of participants. According to FES-I, 52% of them had “fear of falling”. In the previous 12 months, 33.6% of participants had a fall experience, most of the time out of home (21.7%). The 5 top reasons old adult associated to fall is: carpets, shoes, balance, steps and wet floor.

Physical exercise was frequent. The type of exercise most reported is walk (54%), followed by group lessons (19%).

A significant proportion of older adults consider the Self-perceived Health as fair (74.7%), only a few considered as “Very bad” (0.9%).

Table 1 Sociodemographic, anthropometric and lifestyle characteristic, and test scores

Variables	Whole Sample (N = 810)
Age (years)	
M \pm SD	76.46 \pm 7.28
Range	65-103
Sex	
Female <i>n</i> (%)	618 (76.3)
Male <i>n</i> (%)	192 (23.7)

Variables	Whole Sample (N = 810)
Education (years)	
Illiterate <i>n</i> (%)	56 (6.9)
less 4 years <i>n</i> (%)	173 (21.4)
4 years <i>n</i> (%)	425 (52.5)
6 years <i>n</i> (%)	47 (5.8)
9 years <i>n</i> (%)	50 (6.2)
12 years <i>n</i> (%)	28 (3.5)
High education <i>n</i> (%)	31 (3.8)
Municipality	
Cantanhede <i>n</i> (%)	102 (13)
Figueira da Foz <i>n</i> (%)	103 (13)
Mealhada <i>n</i> (%)	168 (21)
Mira <i>n</i> (%)	61 (8)
Montemor-o-Velho <i>n</i> (%)	247 (30)
Penacova <i>n</i> (%)	129 (16)
Obesity classification	
M ± SD	28.78 ± 4.71
Underweight <i>n</i> (%)	8 (1)
Normal range <i>n</i> (%)	154 (19)
Overweight <i>n</i> (%)	348 (43)
Obese Class I <i>n</i> (%)	219 (27)
Obese Class II <i>n</i> (%)	65 (8)
Obese Class III <i>n</i> (%)	16 (2)
Medication	
+5 <i>n</i> (%)	274 (47)
Alcohol habits <i>n</i> (%)	18 (2.2)
Smoking habits <i>n</i> (%)	3 (0.3)
GDS	
M ± SD	11.45 ± 6.4
Depressive symptoms <i>n</i> (%)	340 (42)
TUG	
M ± SD	11.91 ± 9.05
Risk of fall <i>n</i> (%)	344 (42.5)
FES-I M ± SD	29.88 ± 10.76
Fear of falling <i>n</i> (%)	421 (52)
Fall last year <i>n</i> (%)	272 (33.6)
Out of home <i>n</i> (%)	176 (21.7)
5 Top reasons	
Carpets <i>n</i> (%)	237 (29.3)
Shoes <i>n</i> (%)	173 (21.4)
Balance <i>n</i> (%)	160 (19.7)
Steps <i>n</i> (%)	135 (16.6)
Wet floor <i>n</i> (%)	106 (13.0)
Physical activity and exercise	
Yes <i>n</i> (%)	543 (67)

Variables	Whole Sample (N = 810)
Walk <i>n</i> (%)	291 (54)
Group lessons <i>n</i> (%)	103 (19)
Swimming or water aerobics <i>n</i> (%)	81 (15)
Other <i>n</i> (%)	68 (13)
Self-perceived health	
Very good <i>n</i> (%)	17 (2.1)
Good <i>n</i> (%)	142 (17.5)
Fair <i>n</i> (%)	605 (74.7)
Bad <i>n</i> (%)	39 (4.8)
Very bad <i>n</i> (%)	7 (0.9)
Regular use of digital technologies	
Yes <i>n</i> (%)	243 (30)
No <i>n</i> (%)	567 (70)

Abbreviations: GDS, Geriatric Depression Scale; TUG, Timed Up & Go Test; FES-I, European Portuguese version of the Falls Efficacy Scale-International.

A first look at self-report “Radar chart” (Figure 1) shows major differences with participation in the VirtuALL project in four topics: “Relation with technology”, “Cognitive activity”, “Physical activity” and “Balance”. The more accentuated differences were found in “Relation with technology”, maybe because the majority has no contact with any type of technology (70%) (Table 1). Interestingly, participation in VirtuALL increased interest in technology (65%) and a higher percentage of participants (85%) would like to continue using it. Overall, 98% of the participants are completely satisfied with the VirtuALL project (Table 2).

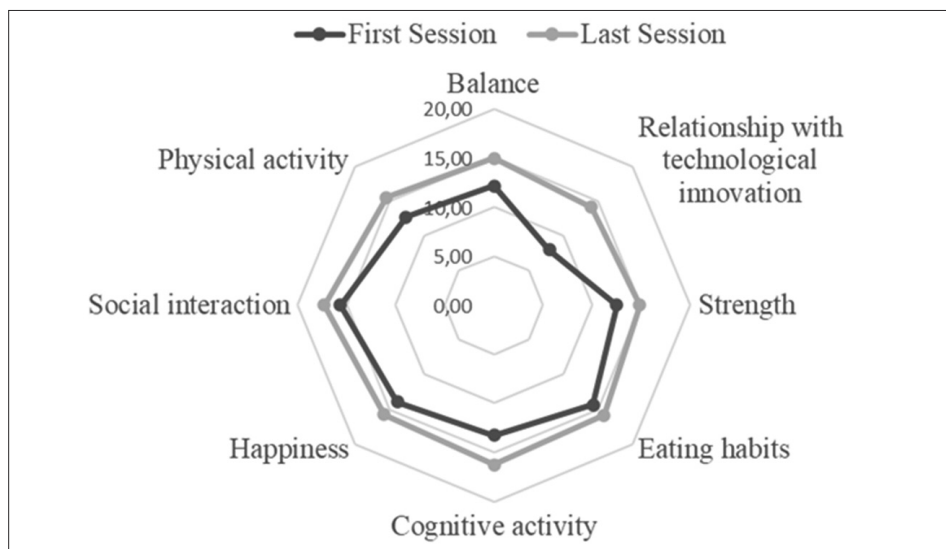


Fig. 1. Radar chart

Table 2 Participants evaluation of the participation in VirtuALL project

Evaluation Questions	Whole Sample (N = 810)
Has your interest in technology increased?	
Strongly Agree <i>n</i> (%)	527 (65)
If you had the opportunity, would you like to continue using the technology?	
Strongly Agree <i>n</i> (%)	689 (85)
Global evaluation of VirtuALL project	
Completely satisfied <i>n</i> (%)	794 (98)

The main evaluation of how the VirtuALL project was important to participants were in three major topics: Innovation, Active and Healthy Aging and Aging in place. The verbatim quotes, as cited by the participants, were translated from Portuguese to English by the authors in Table 3.

Table 3 Participants answer about the importance of VirtuALL project

Major Themes	Subthemes	<i>n</i> (%)	Illustrations
Innovation	Technology and digital skills	168 (21)	“Yes, because it made me aware of the benefits of technological innovation and it was very interesting and innovator.”
	VirtuALL Project	131 (16)	“Very important to me. I worked, had fun and socialized. I had developed other skills. I really enjoyed participating in the VirtuAL project.”
	Empower	159 (20)	“For the knowledge transmitted in relation to active aging.”
Active and Healthy ageing	Mental and Physical active	173 (21)	“I learned more about aging more actively and healthily.”
	Well-being	82 (10)	“Yes, it was important, because it helped to discover new healthier and happier ways of life.”
Ageing in place	Inclusion and Social interaction	97 (12)	“Yes, it was important for social interaction and it helps me to feel integrated.”

Note: The participants' comments were translated by the authors from Portuguese to English for inclusion in this paper.

Discussion

In the present study, the profile of the sociodemographic and anthropometric characteristic, alcohol and smoking habits, mood, falls, physical activity and exercise, self-perceived health of elderly community-dwelling from rural areas that participated in VirtuALL project is globally in line with previous Portuguese studies on old community samples (Brandão et al., 2017; Marques et al., 2014; Midão et al., 2020; Mota-Pinto et al., 2011; Oliveira et al., 2008; Rodrigues et al., 2018; Silva et al., 2019). These findings are consistent with the last Portuguese population census, namely, low education, no computer skills and the women have a higher longevity.

Our finding suggests that prevalence of overweight or obesity is higher. These findings are consistent with previous research on Portuguese older adults (Brandão et al., 2017; Marques et al., 2014; Rodrigues et al., 2018; Silva et al., 2019). According to Rodrigues and colleagues (2018), the oldest participants have underweight, maybe due to undernutrition caused by socioeconomic characteristics, poor appetite, loss of taste and smell and dental deterioration, especially in rural areas.

On the whole sample, the prevalence of polypharmacy and depression are in line with those observed in other studies (Midão, Giardini, Menditto, Kardas, Costa, 2018; Silva et al., 2019), highlighting the higher frequencies of the Portuguese older adults and the importance of development projects, programs, and public policies to deal with these risk factors. Evidence supports that the rates of successful aging are linked to the quality of life and this, in turn, like well-being, at lower levels, are associated with greater medication consumption (Midão et al., 2018). In fact, fall is a significant threat to health and well-being in older people and is a major cause of physical, cognitive, psychological and social abilities deterioration and contributor to morbidity, disability and premature death (Hua et al., 2022). Our findings showed that almost half of the participants are afraid of falling, are more likely to fall and a considerable percentage fell at least once in the previous 12 months, in accordance with other studies (Almada et al., 2020). In agreement with previous reports (Almada et al., 2020; Martins, Silva, Moreira, Guia, Bueno, 2019), our results suggest the majority of falls occur at home. This reinforces the importance of assessing the risk of falling for fall prevention, contributing significantly to the reduction of costs of caring for the individual, the family and the government (Hua et al., 2022).

In addition, an important aspect of health and active aging are physical activity. Several studies, such EpiDoC and SENECA, demonstrated that the Portuguese population have sedentary behaviors (Marques et al., 2014; Rodrigues et al., 2018; Van Staveren, de Groot, Haveman-Nies, 2002). In contrast, in the present study, participants reported 30 minutes or more of physical exercise. Regarding other lifestyle habits, a high proportion do not have alcohol or smoking habits. Other studies found similar results (Rodrigues et al., 2018).

Furthermore, regarding Self-perceived Health, in our sample, the participants reported as “Fair”, but Eurostat (Eurostat, n.d.) appointed that Portuguese perception

is “Very Good and Good”. Currently, few studies address this phenomenon using a uniform methodology. Future research is recommended, because a better understanding has potential to promote longevity free of disease and disability.

Although participants seldom reported no or reduced contact with technology, attending VirtuALL project has increased the desire to continue and the willingness to experience new technologies. The current study provides evidence to claim that a combination of technologies to promote digital skills allows a better performance in physical, cognitive and balance. These findings are particularly significant because there are not many studies that analyse these issues, although there is strong evidence that technology (such virtual reality, augmented and exergame programs) slows the age-related decline process and improves the cognitive and physical abilities of the older adult (Chaze et al., 2022; Kappen et al., 2019; Muñoz et al., 2018; Seifert, Schlomann, 2021).

Considering these issues and the literature, empower older adult to achieve high levels of digital and health may influence the disease trajectory by promoting health consciousness, more physical and cognitive exercise, better stress management, meaningful social network or to use the healthcare services adequately (AIM – International Association of Mutual Benefit, 2020). As project VirtuALL has been showing, different type of technology can shed some light on understanding this potencial to empower elderly people to achieve high levels of digital and health literacy and foster inclusion. These results should be interpreted cautiously, because this research was a convenience sampling and involved self-reported measures, with possible response bias. It would be interesting to include a larger sample that represents the Portuguese population, adopt random sampling and follow-up.

Despite these limitations, this study covered a large sample of the center region of Portugal, and covered municipalities of Cantanhede, Figueira da Foz, Mealhada, Mira, Montemor-o-Velho and Penacova. In Portugal, there have been several cognitive program/training studies or even computerized cognitive stimulation for this population, but in our understating, this is the first study that assessed people aged 65 or over, in 6 municipalities at the same time, using physical and cognitive stimulation through augmented reality and virtual reality. This study provides an important general picture of this population that can be useful to local policies to develop programs or projects directed to this population and allows the identification of the specific characteristics and needs that should be addressed. This increase of knowledge may facilitate an interdisciplinary approach that just might bring new insights into how the elderly learn and be inspired by what technology can do for them, focusing on the opportunities given by digital and green transformation and its effects.

As far as our opinion is concerned, older adults with similiar profile living in other regions of Portugal can benefit from this project. In this sense, the VirtuALL project should be further promoted so that more elderly can benefit from it.

Conclusion

To sum up, the current study indicated that the VirtuALL project was effective in improving digital skills, social interaction, physical and cognitive function in elderly community-dwelling from rural areas. Illiterate participants or with lower education were found to benefit from the combination between different technology with social innovation. Therefore, this characteristic is commonly found among elderly in Portugal, the current study reinforces the importance of this kind of projects in the digital literacy, but also, in the health promotion and disease prevention action in later life.

Acknowledgments:

The present project was granted by Portugal Inovação Social (Project co-financed by the European Union, through the European Social Fund) POISE-O3-4639-FSE-000299

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