MARIO Project: A Multicenter Survey About Companion Robot Acceptability in Caregivers of Patients with Dementia

Daniele Sancarlo, Grazia D'Onofrio, James Oscar, Francesco Ricciardi, Dympna Casey, Keith Murphy, Francesco Giuliani and Antonio Greco

Abstract In the frame of the European Community funded MARIO, caregivers of 139 dementia patients were recruited in National University of Ireland (NUIG), in Geriatrics Unit of IRCCS "Casa Sollievo della Sofferenza"-Italy (IRCCS) and in Alzheimer Association Bari-Italy (AAB) for a multicenter survey on to determine the needs and preferences of caregivers for improving the assistance of dementia patients, and guiding technological development of MARIO. A six minute video on technological devices and functions of MARIO was showed, and all caregivers fulfilled a 43-item questionnaire that explored four areas: (A) Acceptability, (B) Functionality, (C) Support devices, and (D) Impact. Caregivers declared that to

---

Grazia D'Onofrio—Macroarea of interest: Disability and rehabilitation.

D. Sancarlo · G. D'Onofrio (✉) · A. Greco
Geriatrics Unit & Laboratory of Gerontology and Geriatrics, Department of Medical Sciences, IRCCS "Casa Sollievo Della Sofferenza", San Giovanni Rotondo, Foggia, Italy
e-mail: graziadonofrio@libero.it; g.donofrio@operapadrepio.it

D. Sancarlo
e-mail: sancarlodaniele@yahoo.it

A. Greco
e-mail: a.greco@operapadrepio.it

J. Oscar · D. Casey · K. Murphy
National University of Ireland, Galway, Ireland
e-mail: oscar.ben.james@gmail.com

D. Casey
e-mail: dympna.casey@nuigalway.ie

K. Murphy
e-mail: Kathy.murphy@nuigalway.ie

F. Ricciardi · F. Giuliani
ICT, Innovation and Research Unit, IRCCS "Casa Sollievo Della Sofferenza",
San Giovanni Rotondo, Foggia, Italy
e-mail: f.ricciardi@operapadrepio.it

F. Giuliani
e-mail: f.giuliani@operapadrepio.it

facilitate acceptance (over 17.5%) and to improve functionality of MARIO (over 29%) should be important/likely/useful. Over 20.3% of caregivers reported that following support devices in MARIO could be useful for their patients: (1) for monitoring bed-rest and movements, (2) for monitoring the medication use, (3) for monitoring the ambient environmental conditions, (4) for regulating heating, humidity, lighting and TV channel, (5) for undertaking comprehensive geriatric assessment, (6) for link to care planning, (7) for monitoring physiological deterioration, and (8) for monitoring cognitive deterioration. Over 21.8% of caregivers declared that MARIO should be useful to improve quality of life, quality of care, safety, emergency communications, home-based physical and/or cognitive rehabilitation programs, and to detect isolation and health status changes of their patients. MARIO is a novel approach employing robot companions, and its effect will be: (1) to facilitate and support persons with dementia and their caregivers, and (2) reduce social exclusion and isolation.

Keywords Building resilience for loneliness and dementia · Comprehensive geriatric assessment · Caring service robots · Acceptability · Quality of life · Quality of care · Safety

1   Introduction

Europe has the highest prevalence of dementia in the world; seven million people are currently affected and this is projected to increase to 13.4 million by 2050 [1]. Across EU countries, participation of people with dementia in family and civic life is diminished by cultures of exclusion and stigmatisation [2]. Less severe and even more widespread, loneliness, isolation and depression are becoming increasingly important within Social Care. The increased mortality risk associated with the effects of these conditions is 200% greater than that of clinical obesity and comparable to the effects of smoking 15 cigarettes a day [3]. These effects include impaired immune functions, increased blood pressure, inflammation, anxiety, increased risk for heart disease, stroke and others [4]. Dementia is characterised by impaired mental functioning, language and thinking [5]. These impairments are often accompanied by personality, functional and behavioural changes.

To fight loneliness and the effects suffered by person with dementia, effective techniques include those that target change of a person's perception of loneliness and those that increase a person's resilience. Resilience is an adaptive capacity that refers to one's ability to 'bounce back' and cope in the face of adversity.

ICT solutions can be used to increase psychological skills like resilience [6], and to manage active and healthy aging with the use of caring service robots as will be explored with the EU funded MARIO project [7].

In this project specific technological tools are adopted that try to create real feelings and affections making it easier for the patient to accept assistance from a

robot when—in certain situations—in return the human can also support the machine.

The approach targeted in MARIO is the Comprehensive Geriatric Assessment (CGA) on which the Multidimensional Prognosis Index (MPI) [8] is based. Used effectively, the MPI can improve dramatically diagnostic accuracy, optimize medical treatment and health outcomes, improve function and quality of life, reduce use of unnecessary formal services, and institute or improve long-term care management.

In MARIO, the service robot will provide information to MPI survey and evaluation process based on its observation of the instrumental activities of daily living and detection of changes regarding them.

The aim and ambition of the project are:

- to address and make progress on the challenging problems of loneliness, isolation and dementia in older persons through multi-faceted interventions delivered by service robots
- to conduct near project length interaction with end users and assisted living environments to enable iterative development and preparation for post project uptake
- to assist caregivers and physicians in the CGA of subjects at risk to loneliness, isolation or dementia through the use of service robots
- the use of near state of the art robotic platforms that are flexible, modular friendly, low cost and close to market ready in order to realize field contributions in the immediate future
- to make Mario capable to support and receive "robot applications" similar to the developer and app community for smartphones. This will empower development and creativity, enable the robot to perform new functionalities over time, and support discovery and improve usefulness for end users while lowering costs
- through novel advances in machine learning techniques and semantic analysis methods to make Mario more personable, useful, and accepted by end users (e.g. gain perception of non-loneliness).

To bring MARIO service robot concepts out of the lab and into industry by addressing licensing aspects via Apache, the integration of telecommunication aspects and application hosting environment.

In the first stage of the project, a series of mini-workshops locally at the pilot sites with partner organizations to introduce MARIO to both end users and stakeholders were done. After an interview about determining the needs and preferences of patients were performed.

The caregivers play a pivotal role in the management of the health and care of dementia patients, but although caregiving may be rewarding, providing care to a family member is stressful [9]. These negative consequences can affect the quality of life of patients and informal caregivers, and finally the quality of care of the patients and increase the likelihood of institutionalization [10].

The informal caregivers of dementia patients are early overwhelmed by care responsibilities and others showing stability or even decreases in the burden over time [11].

It was shown that the amount of time of informal care is the frequent reporting of up to 24 h per day, leading to very high cost estimates that may overlook aspects of joint production (i.e. caregivers performing multiple tasks simultaneously) [12]. Several studies were shown that the caregiver burden leads to higher levels of depression and anxiety [13, 14], use of psychotropic medication more frequently [15], engagement in fewer protective health behaviours, and increased risk of medical illness [16, 17] and mortality [18].

In this perspective, the ICT may provide promising new tools to improve the functional and cognitive assessment of patients with dementia and related disorders [19]. Development and implementation of novel computer-based ICT applications in the field of cognitive impairment mitigation and rehabilitation [20], emerging ICT applications based on virtual reality environments, including Augmented Reality technology, are become important game changers [19]. The ICT concept and approach can support the range of activities of daily living [21], monitor the circadian rhythm [22] for dementia patients.

The goal of this paper was to determine the needs and preferences of formal and informal caregivers for improving the assistance of dementia patients, and guiding the technological development of the MARIO though a questionnaire.

2   Materials and Methods

This study fulfilled the Declaration of Helsinki, the guidelines for Good Clinical Practice, and the Strengthening the Reporting of Observational Studies in Epidemiology guidelines. The approval of the study for experiments using human subjects was obtained from the local ethics committees on human experimentation. Written informed consent for research was obtained from each patient or from relatives or a legal representative in the case of severe demented patients. Caregivers of dementia patients consecutively recruited from May 2015 to February 2016 in the National University of Ireland (NUIG, Galway, Ireland), in the Geriatrics Unit of the Casa Sollievo della Sofferenza Hospital (IRCCS, San Giovanni Rotondo, Italy), and in the Alzheimer Association Bari (AAB, Bari, Italy) were screened for eligibility.

Inclusion criteria were: (1) caregiver of patients with diagnosis of dementia according to the criteria of the National Institute on Aging-Alzheimer's Association (NIAAA) [23]; and (2) the ability to provide an informed consent or availability of a proxy for informed consent. Exclusion criteria were: caregivers of patients with serious comorbidity, tumors and other diseases that could be causally related to cognitive impairment (ascertained blood infections, vitamin B12 deficiency, anaemia, disorders of the thyroid, kidneys or liver), history of alcohol or drug abuse, head trauma, psychoactive substance use and other causes of memory impairment.

The following parameters were collected by a systematic interview about the caregivers: gender, age, educational level (in years), and caregiving type [Informal caregiver (unpaid), Informal caregiver (paid), Formal caregiver (Geriatrician), Formal caregiver (Psychologist) and Forma caregiver (Nurse)].

To all caregivers were shown a video on the technological devices and the functions that should been implemented in MARIO (video weblink: https://www.youtube.com/watch?v=v1s2Hbad1l0).

Shortly after watching the video, a questionnaire was administered to all caregivers (MARIO Questionnaire) designed to find out their perceptions about robot companions, especially what they would like such a robot to do for them, and how robots could be designed to build their resilience.

The MARIO Questionnaire (Appendix 1) included 43 items that explored four areas: (A) Acceptability; (B) Functionality; (C) Support devices; and (D) Impact.

It was a quantitative questionnaire based on a Likert scale of "Extremely important/likely/useful" and "YES, very useful" to "Not at all important/likely/useful" and "Not useful at all".

All the analyses were made with the SPSS Version 20 software package (SPSS Inc., Chicago, IL). For dichotomous variables, differences between the groups were tested using the Fisher exact test. This analysis was made using the 2-Way Contingency Table Analysis available at the Interactive Statistical Calculation Pages (http://statpages.org/). For continuous variables, normal distribution was verified by the Shapiro–Wilk normality test and the 1-sample Kolmogorov–Smirnov test. For normally distributed variables, differences among the groups were tested by the Welch 2-sample t test or analysis of variance under general linear model. For non normally distributed variables, differences among the groups were tested by the Wilcoxon rank sum test with continuity correction or the Kruskal–Wallis rank sum test. Test results in which the p value was smaller than the type 1 error rate of 0.05 were declared significant.

3   Results

During the enrolment period, 130 caregivers were recruited: 39 caregivers were from NUIG (M = 4, F = 35), 70 caregivers from IRCCS (M = 28, F = 42), and 21 caregivers from AAB (M = 8, F = 13). Table 1 shows that the demographic and clinical characteristics of the three groups of caregivers according to their residence country. The three groups of caregivers did not differ in following parameters: gender distribution (p = 0.876) and mean age (p = 0.473). Significant differences were observed in educational level (NUIG = 18.88 vs. IRCCS = 14.90 vs. AAB = 15.61 years, p = 0.006). NUIG and IRCCS showed an higher presence of nurses (NUIG = 56.1% and IRCCS = 38.6%), and IRCCS showed an high presence of Informal caregivers unpaid (IRCCS = 72.7%), Informal caregivers paid (IRCCS = 85.7%) and Formal caregivers (Geriatrician) (IRCCS = 94.7%) with a significance of p < 0.0001 compared to other caregivers types.

Table 1 Characteristics of dementia caregivers

	ALL	NUIG	IRCCS	AAB	*P* value
	N = 130	N = 39	N = 70	N = 21	
Gender (M/F)	36/55	4/35	28/42	8/13	0.004
Age (years)[a] Range	48.12 ± 15.81 23–88	–	48.74 ± 14.90 23–88	45.72 ± 19.25 24–82	0.473
Educational level (years)[a] Range	16.09 ± 6.00 0–24	18.88 ± 1.22 18–23	14.90 ± 7.06 0–23	15.61 ± 5.30 5–24	0.006
Caregiving types					
Informal caregiver (unpaid) N(%)	33 (25.3)	0 (0)	24 (72.7)	9 (27.3)	<0.0001
Informal caregiver (paid) N(%)	7 (5.4)	0 (0)	6 (85.7)	1 (14.3)	
Formal caregiver (Geriatrician) N(%)	19 (14.6)	0 (0)	18 (94.7)	1 (5.3)	
Formal caregiver (Psychologist) N(%)	7 (5.4)	0 (0)	0 (0)	7 (100.0)	
Formal caregiver (Nurse) N(%)	57 (43.9)	32 (56.1)	22 (38.6)	3 (5.3)	
Not indicated (N%)	7 (5.4)	7 (100.0)	0 (0)	0 (0)	

[a]Values are presented as mean ± standard deviation

3.1 Acceptability and Functionality of Caring Service Robot

As shown in Table 2 within 60.4% of caregivers of dementia patients declared that the Section A Items should be very important/likely/useful or extremely important/likely/useful to facilitate acceptance of caring service robot.

Within 52.8% of caregivers of dementia patients declared that the Section B Items should be very important/likely/useful or extremely important/likely/useful to improve the functionality of caring service robot.

3.2 Support Devices and Impact of Caring Service Robot

As shown in Table 3 within 65.9% of caregivers reported that following support devices in MARIO could be very useful or moderately useful for their patients:

Table 2 Percentage of responses by caregivers of dementia patients to the MARIO questionnaire (Section A: Acceptability, and Section B: Functionality)

Items	Extremely important/likely/useful N(%)	Very important/likely/useful N(%)	Moderately important/likely/useful N(%)	Slightly important/likely/useful N(%)	Not at all important/likely/useful N(%)
Section A: Acceptability					
1	69 (53.5%)	33 (25.6%)	22 (17.1%)	0 (0%)	5 (3.9%)
2	72 (55.8%)	39 (30.2%)	15 (11.6%)	1 (0.8%)	2 (1.6%)
3	72 (56.2%)	30 (23.4%)	17 (13.3%)	4 (3.1%)	5 (3.9%)
4	45 (49.5%)	29 (31.9%)	14 (15.4%)	0 (0%)	3 (3.3%)
5	55 (43.0%)	38 (29.7%)	26 (20.3%)	5 (3.9%)	4 (3.1%)
6	61 (48.0%)	41 (32.3%)	18 (14.2%)	2 (1.6%)	5 (3.9%)
7	61 (47.7%)	40 (31.6%)	22 (17.2%)	0 (0%)	5 (3.9%)
8	50 (40.0%)	31 (24.8%)	25 (20.0%)	14 (11.2%)	5 (4.0%)
9	47 (36.7%)	25 (19.5%)	33 (25.8%)	16 (12.5%)	7 (5.5%)
10	52 (40.9%)	35 (27.6%)	28 (22.0%)	8 (6.3%)	4 (3.1%)
11	48 (37.5%)	38 (29.7%)	23 (18.0%)	14 (10.9%)	5 (3.9%)
12	53 (42.1%)	50 (39.7%)	20 (15.9%)	0 (0%)	3 (2.4%)
13	60 (46.9%)	46 (35.9%)	15 (11.7%)	3 (2.3%)	4 (3.1%)
14	52 (40.6%)	40 (31.2%)	23 (18.0%)	8 (6.2%)	5 (3.9%)
15a*	35 (60.3%)	11 (19.0%)	8 (13.3%)	4 (6.9%)	0 (0%)
15b*	31 (54.44%)	17 (29.8%)	5 (8.8%)	2 (3.5%)	2 (3.5%)
15c*	24 (42.1%)	10 (17.5%)	18 (31.6%)	4 (7.0%)	1 (1.8%)
15d*	27 (46.6%)	13 (22.4%)	4 (6.9%)	7 (12.1%)	7 (12.1%)
15e*	13 (22.4%)	18 (31.0%)	9 (15.5%)	11 (19.0%)	7 (12.1%)
15f*	16 (27.6%)	16 (27.6%)	10 (17.2%)	10 (17.2%)	6 (10.3%)
15g*	19 (32.8%)	13 (22.4%)	10 (17.2%)	12 (20.7%)	4 (6.9%)

(continued)

Table 2 (continued)

Items	Extremely important/likely/useful N(%)	Very important/likely/useful N(%)	Moderately important/likely/useful N(%)	Slightly important/likely/useful N(%)	Not at all important/likely/useful N(%)
Section B: Functionality					
1	58 (45.7%)	49 (38.6%)	13 (10.2%)	4 (3.1%)	3 (2.4%)
2	63 (49.6%)	46 (36.2%)	14 (11.0%)	1 (0.8%)	3 (2.4%)
3	59 (46.5%)	43 (33.1%)	22 (17.3%)	1 (0.8%)	3 (2.4%)
4	63 (49.6%)	43 (33.9%)	18 (14.2%)	0 (0%)	3 (2.4%)
5	56 (44.4%)	43 (34.1%)	17 (13.5%)	7 (5.6%)	3 (2.4%)
6	59 (46.8%)	45 (35.7%)	17 (13.5%)	2 (1.6%)	3 (2.4%)
7	59 (46.8%)	45 (35.7%)	19 (15.1%)	0 (0%)	3 (2.4%)
8	57 (45.2%)	46 (36.5%)	20 (15.9%)	0 (0%)	3 (2.4%)
9	62 (48.8%)	45 (35.4%)	17 (13.4%)	0 (0%)	3 (2.4%)
10	60 (48.4%)	45 (36.3%)	15 (12.1%)	1 (0.8%)	3 (2.4%)
11	50 (40.0%)	42 (33.6%)	25 (20.0%)	1 (0.8%)	7 (5.6%)
12	67 (52.8%)	37 (29.1%)	19 (15.0%)	1 (0.8%)	3 (2.4%)
13	45 (48.44%)	32 (34.4%)	12 (12.9%)	1 (1.1%)	3 (3.2%)

*Extremely important/likely/useful = 6–7 ranks; Very important/likely/useful = 4–5 ranks; Moderately important/likely/useful = 3 rank; Slightly important/likely/useful = 2 rank; Not at all important/likely/useful = 1 rank

Table 3 Percentage of responses by caregivers of dementia patients to the MARIO Questionnaire (Section C: Support Devices, and Section D: Impact)

Items	YES, very useful	YES, moderately useful	YES, low level of usefulness	Not useful at all
Section C: Support devices				
1	80 (65.0%)	28 (22.8%)	13 (10.6%)	2 (1.6%)
2	81 (65.9%)	25 (20.3%)	14 (11.4%)	3 (2.4%)
3	80 (65.0%)	29 (23.6%)	12 (9.8%)	2 (1.6%)
4	66 (53.7%)	37 (30.1%)	16 (13.0%)	4 (3.3%)
5	60 (48.8%)	37 (30.1%)	20 (16.3%)	6 (4.9%)
6	65 (52.8%)	36 (29.3%)	16 (13.0%)	6 (4.9%)
7	70 (57.4%)	35 (28.7%)	13 (10.7%)	4 (3.3%)
8	70 (56.9%)	35 (28.5%)	15 (12.2%)	3 (2.4%)
Section D: Impact				
1	65 (52.4%)	38 (30.6%)	18 (14.5%)	3 (2.4%)
2	65 (52.4%)	40 (32.3%)	16 (12.9%)	3 (2.4%)
3	67 (54.0%)	36 (29.0%)	16 (12.9%)	5 (4.0%)
4	80 (64.5%)	27 (21.8%)	14 (11.3%)	3 (2.4%)
5	71 (57.3%)	36 (29.0%)	13 (10.5%)	4 (3.2%)
6	71 (57.3%)	35 (28.2%)	14 (11.3%)	4 (3.2%)
7	70 (57.4%)	34 (27.9%)	15 (12.3%)	3 (2.5%)

(1) Devices for monitoring bed-rest and movements, (2) Devices for monitoring the medication use, (3) Devices for monitoring the ambient environmental conditions, (4) Devices for regulating heating, humidity, lighting and TV channel, (5) Devices for undertaking comprehensive geriatric assessment, (6) Devices that link to care planning, (7) Devices for monitoring physiological deterioration, and (8) Devices for monitoring cognitive deterioration.

Within 64.5% of caregivers of dementia patients declared that MARIO should be very useful or moderately useful to improve quality of life, quality of care, safety, emergency communications, home-based physical and/or cognitive rehabilitation programs, and to detect isolation and health status changes of their patients.

3.3 Effects of Sex and Age of the Caregivers

As shown in Table 4 the caring service robot were deemed more useful in supporting the female than male in following items: Section A Item 1 ($p = 0.008$), Item 2 ($p < 0.0001$), Item 4 ($p = 0.004$), Item 6 ($p = 0.047$), Item 12 ($p = 0.020$), and Item 13 ($p = 0.010$); Section B Item 1 ($p = 0.003$), Item 4 ($p = 0.024$), Item 7 ($p = 0.011$), Item 10 ($p = 0.009$), Item 11 ($p = 0.018$), Item 12 ($p = 0.018$), and Item 13 ($p = 0.001$); Section C Item 1 ($p = 0.015$), Item 3 ($p = 0.037$), Item 4 ($p = 0.019$), Item 6 ($p = 0.015$), Item 7 ($p < 0.0001$) and Item 8 ($p = 0.005$);

Table 4 Effects of sex and age of the caregivers of dementia patients on the "Extremely important/likely/useful" and "Very important/likely/useful responses" to the MARIO Questionnaire (Section A: Acceptability, and Section B: Functionality, Section C: Support Devices, and Section D: Impact)

Items	SEX			AGE			
	M	F	P value	20–34 years	35–49 years	≥ 50 years	P value
Section A: Acceptability							
1	26 (65.0%)	76 (85.4%)	0.008	11 (68.8%)	29 (85.3%)	32 (84.2%)	**0.323**
2	28 (70.0%)	83 (93.3%)	<0.0001	13 (81.2%)	30 (88.2%)	31 (81.6%)	**0.700**
3	32 (82.1%)	70 (78.7%)	**0.660**	13 (81.2%)	31 (91.2%)	34 (89.5%)	**0.574**
4	24 (66.7%)	50 (90.9%)	0.004	11 (68.8%)	30 (88.2%)	32 (84.2%)	**0.224**
5	26 (65.0%)	67 (76.1%)	**0.190**	9 (56.2%)	27 (79.4%)	29 (76.3%)	**0.199**
6	28 (70.0%)	74 (85.1%)	0.047	11 (68.8%)	27 (79.4%)	32 (84.2%)	**0.437**
7	29 (72.5%)	72 (81.8%)	**0.231**	12 (75.0%)	28 (82.4%)	32 (84.2%)	**0.722**
8	24 (60.0%)	57 (67.1%)	**0.441**	8 (50.0%)	26 (76.5%)	31 (81.6%)	**0.050**
9	24 (60.0%)	48 (54.5%)	**0.564**	7 (43.8%)	27 (79.4%)	30 (78.9%)	0.016
10	26 (65.0%)	61 (70.1%)	**0.564**	8 (50.0%)	28 (82.4%)	30 (78.9%)	0.036
11	25 (62.5%)	61 (69.3%)	**0.446**	9 (56.2%)	31 (91.2%)	28 (73.7%)	0.018
12	28 (70.0%)	75 (87.2%)	0.020	10 (62.5%)	31 (91.2%)	29 (76.3%)	**0.052**
13	28 (70.0%)	78 (88.6%)	0.010	11 (68.8%)	31 (91.2%)	30 (78.9%)	**0.132**
14	26 (65.0%)	66 (75.0%)	**0.243**	8 (50.0%)	31 (91.2%)	29 (76.3%)	0.005
Section B: Functionality							
1	28 (70.0%)	79 (90.8%)	0.003	12 (75.0%)	27 (79.4%)	31 (81.6%)	**0.861**
2	31 (77.5%)	78 (89.7%)	**0.068**	13 (81.2%)	28 (82.4%)	32 (84.2%)	**0.959**
3	29 (72.5%)	72 (82.8%)	**0.183**	13 (81.2%)	28 (82.4%)	32 (84.2%)	**0.959**
4	29 (72.5%)	77 (88.5%)	0.024	13 (81.2%)	29 (85.3%)	33 (86.8%)	**0.869**
5	28 (70.0%)	71 (82.6%)	**0.110**	12 (75.0%)	27 (79.4%)	33 (86.8%)	**0.528**
6	30 (75.0%)	74 (86.0%)	**0.128**	12 (75.0%)	29 (85.3%)	33 (86.8%)	**0.538**
7	28 (70.0%)	76 (88.4%)	0.011	10 (62.5%)	27 (79.4%)	33 (86.8%)	**0.129**

(continued)

Table 4 (continued)

Items	SEX			AGE			
	M	F	P value	20–34 years	35–49 years	≥50 years	P value
8	29 (72.5%)	74 (86.0%)	**0.067**	11 (68.8%)	28 (82.4%)	33 (86.8%)	**0.288**
9	30 (75.0%)	77 (88.5%)	**0.052**	11 (68.8%)	29 (85.3%)	31 (81.6%)	**0.378**
10	29 (72.5%)	76 (90.5%)	0.009	12 (75.0%)	29 (85.3%)	32 (84.2%)	**0.641**
11	24 (60.0%)	68 (80.0%)	0.018	12 (75.0%)	28 (82.4%)	30 (78.9%)	**0.829**
12	28 (70.0%)	76 (87.4%)	0.018	13 (81.2%)	28 (82.4%)	31 (81.6%)	**0.994**
13	24 (66.7%)	53 (93.0%)	0.001	12 (75.0%)	30 (88.2%)	31 (81.6%)	**0.487**
Section C: Support devices							
1	31 (77.5%)	77 (92.8%)	0.015	13 (81.2%)	32 (94.1%)	32 (84.2%)	**0.315**
2	33 (82.5%)	73 (88.0%)	**0.412**	13 (81.2%)	32 (94.1%)	35 (92.1%)	**0.317**
3	32 (80.0%)	77 (92.8%)	0.037	13 (81.2%)	32 (94.1%)	33 (86.8%)	**0.367**
4	29 (72.5%)	74 (89.2%)	0.019	12 (75.0%)	32 (94.1%)	32 (84.2%)	**0.162**
5	28 (70.0%)	69 (83.1%)	**0.095**	11 (68.8%)	32 (94.1%)	31 (81.6%)	**0.062**
6	28 (70.0%)	73 (88.0%)	0.015	10 (62.5%)	32 (94.1%)	31 (81.6%)	0.020
7	27 (69.2%)	78 (94.0%)	<0.0001	12 (75.0%)	32 (94.1%)	32 (84.2%)	**0.162**
8	29 (72.5%)	76 (91.6%)	0.005	13 (81.2%)	32 (94.1%)	32 (84.2%)	**0.315**
Section D: Impact							
1	28 (70.0%)	75 (89.3%)	0.007	10 (62.5%)	31 (91.2%)	32 (84.2%)	0.041
2	30 (75.0%)	75 (89.3%)	0.039	12 (75.0%)	32 (94.1%)	32 (84.2%)	**0.162**
3	30 (75.0%)	73 (86.9%)	**0.098**	10 (62.5%)	32 (94.1%)	33 (86.8%)	0.012
4	30 (75.0%)	77 (91.7%)	0.012	13 (81.2%)	32 (94.1%)	33 (86.8%)	**0.367**
5	31 (77.5%)	76 (90.5%)	**0.050**	12 (75.0%)	31 (91.2%)	35 (92.1%)	**0.163**
6	31 (77.5%)	75 (89.3%)	**0.082**	11 (68.8%)	31 (91.2%)	34 (89.5%)	**0.074**
7	29 (72.5%)	75 (91.5%)	0.006	11 (68.8%)	31 (91.2%)	33 (86.8%)	**0.106**

The significative p-values (<0.050) should be in bold

Table 5 Effects of educational level of the caregivers of dementia patients on the "Extremely important/likely/useful" and "Very important/likely/useful responses" to the MARIO Questionnaire (Section A: Acceptability, and Section B: Functionality, Section C: Support Devices, and Section D: Impact)

Items	Low education	High school diploma	Degree	*P* value
Section A: Acceptability				
1	23 (88.5%)	5 (55.6%)	66 (77.6%)	**0.114**
2	22 (84.6%)	5 (55.6%)	77 (90.6%)	0.012
3	24 (92.3%)	7 (77.8%)	65 (77.4%)	**0.236**
4	22 (84.6%)	6 (66.7%)	45 (84.9%)	**0.390**
5	23 (88.5%)	5 (55.6%)	59 (69.4%)	**0.081**
6	23 (88.5%)	7 (77.8%)	64 (76.2%)	**0.404**
7	24 (92.3%)	6 (66.7%)	64 (75.3%)	**0.124**
8	24 (92.3%)	6 (66.7%)	48 (58.5%)	0.006
9	23 (88.5%)	5 (55.6%)	40 (47.1%)	0.001
10	23 (88.5%)	7 (77.8%)	54 (63.5%)	0.046
11	22 (84.6%)	4 (44.4%)	57 (67.1%)	**0.059**
12	23 (88.5%)	4 (44.4%)	71 (84.5%)	0.007
13	22 (84.6%)	6 (66.7%)	72 (84.7%)	**0.378**
14	22 (84.6%)	5 (55.6%)	61 (71.8%)	**0.197**
Section B: Functionality				
1	23 (88.5%)	6 (66.7%)	71 (83.5%)	**0.317**
2	24 (92.3%)	6 (66.7%)	72 (84.7%)	**0.177**
3	23 (88.5%)	8 (88.9%)	66 (77.6%)	**0.385**
4	24 (92.3%)	8 (88.9%)	68 (80.0%)	**0.303**
5	24 (92.3%)	8 (88.9%)	62 (73.8%)	**0.097**
6	24 (92.3%)	8 (88.9%)	67 (79.8%)	**0.292**
7	24 (92.3%)	8 (88.9%)	66 (78.6%)	**0.239**
8	24 (92.3%)	8 (88.9%)	65 (74.3%)	**0.193**
9	23 (88.5%)	7 (77.8%)	71 (83.5%)	**0.718**
10	23 (88.5%)	8 (88.9%)	67 (81.7%)	**0.654**
11	22 (84.6%)	6 (66.7%)	59 (71.1%)	**0.346**
12	23 (88.5%)	7 (77.8%)	70 (82.4%)	**0.687**
13	22 (84.6%)	6 (66.7%)	47 (85.5%)	**0.366**
Section C: Support devices				
1	24 (92.3%)	7 (77.8%)	76 (89.4%)	**0.586**
2	23 (88.5%)	9 (100.0%)	71 (83.5%)	**0.244**
3	23 (88.5%)	8 (88.9%)	76 (89.4%)	**0.990**
4	23 (88.5%)	7 (77.8%)	72 (84.7%)	**0.734**
5	23 (88.5%)	7 (77.8%)	66 (77.6%)	**0.476**
6	23 (88.5%)	7 (77.8%)	70 (82.4%)	**0.687**
7	23 (88.5%)	7 (77.8%)	73 (86.9%)	**0.710**
8	23 (88.5%)	7 (77.8%)	73 (85.9%)	**0.730**

(continued)

Table 5 (continued)

Items	Low education	High school diploma	Degree	*P* value
Section D: Impact				
1	23 (88.5%)	8 (88.9%)	70 (81.4%)	**0.628**
2	23 (88.5%)	8 (88.9%)	72 (83.7%)	**0.793**
3	23 (88.5%)	8 (88.9%)	69 (80.2%)	**0.547**
4	23 (88.5%)	8 (88.9%)	73 (84.9%)	**0.869**
5	24 (92.3%)	9 (100.0%)	71 (82.6%)	**0.206**
6	24 (92.3%)	9 (100.0%)	70 (81.4%)	**0.167**
7	23 (88.5%)	8 (88.9%)	70 (83.3%)	**0.768**

The significative *p*-values (<0.050) should be in bold

Section D Item 1 (p = 0.007), Item 2 (p = 0.039), Item 4 (p = 0.012), and Item 7 (p = 0.006).

The caring service robot were deemed more useful in supporting the caregivers who had an age ≥ 35 years than younger in following items: Section A Item 9 (p = 0.016), Item 10 (p = 0.036), Item 11 (p = 0.018), and Item 14 (p = 0.005); Section C Item 6 (p = 0.020); Section D Item 1 (p = 0.041) and Item 3 (p = 0.012).

3.4 *Effects of Educational Level and Caregiving Types of the Caregivers*

As shown in Table 5 the caring service robot were deemed more useful in supporting the caregivers who had a low educational level in following items: Section A Item 2 (p = 0.012), Item 8 (p = 0.006), Item 9 (p = 0.001), Item 10 (p = 0.046) and Item 12 (p = 0.007).

As shown in Table 6, the caring service robot were deemed more useful in supporting the informal caregivers (unpaid or paid) than formal caregivers in following items: Section A Item 5 (p = 0.048), Item 8 (p = 0.013) and Item 9 (p = 0.001); Section D Item 1 (p = 0.002) and Item 6 (p = 0.010).

4 Discussion

The MARIO robot were deemed very useful in supporting the informal caregivers (unpaid and paid) who were female and had an age ≥ 35 and with low educational level. Indeed, the informal caregivers had more difficulty to manage the dementia patients at home; moreover, who were female, younger and with a lower educational level clearly found even more complexity in management of dementia patients, requiring even more help from the companion robot.

Table 6 Effects of caregiving types of the caregivers of dementia patients on the "Extremely important/likely/useful" and "Very important/likely/useful responses" to the MARIO Questionnaire (Section A: Acceptability, and Section B: Functionality, Section C: Support Devices, and Section D: Impact)

Items	Informal caregiver (unpaid)	Informal caregiver (paid)	Formal caregiver (Geriatr.)	Formal caregiver (Nurse)	Formal caregiver (Psychol.)	P value
Section A: Acceptability						
1	25 (75.8%)	7 (100.0%)	16 (84.2%)	41 (73.2%)	6 (85.7%)	**0.482**
2	24 (72.7%)	7 (100.0%)	16 (84.2%)	51 (91.1%)	7 (100.0%)	**0.078**
3	29 (87.9%)	7 (100.0%)	16 (84.2%)	40 (72.7%)	7 (100.0%)	**0.133**
4	24 (72.7%)	7 (100.0%)	16 (84.2%)	21 (84.0%)	6 (85.7%)	**0.474**
5	25 (75.8%)	7 (100.0%)	14 (73.7%)	40 (71.4%)	2 (28.6%)	0.048
6	28 (84.8%)	7 (100.0%)	14 (73.7%)	42 (76.4%)	5 (71.4%)	**0.498**
7	27 (81.8%)	7 (100.0%)	14 (73.7%)	40 (71.4%)	7 (100.0%)	**0.213**
8	26 (78.8%)	6 (85.7%)	13 (68.4%)	32 (60.4%)	1 (14.3%)	0.013
9	25 (75.8%)	6 (85.7%)	14 (73.7%)	22 (39.3%)	2 (28.6%)	0.001
10	27 (81.8%)	6 (85.7%)	13 (68.4%)	37 (66.1%)	2 (28.6%)	**0.058**
11	23 (69.7%)	6 (85.7%)	16 (84.2%)	36 (64.3%)	3 (42.9%)	**0.216**
12	24 (72.7%)	6 (85.7%)	16 (84.2%)	46 (83.6%)	6 (85.7%)	**0.728**
13	25 (75.8%)	6 (85.7%)	16 (84.2%)	48 (85.7%)	5 (71.4%)	**0.727**
14	24 (72.7%)	6 (85.7%)	16 (84.2%)	38 (67.9%)	4 (57.1%)	**0.506**
Section B: Functionality						
1	27 (81.8%)	7 (100.0%)	14 (73.7%)	48 (85.7%)	6 (85.7%)	**0.555**
2	28 (84.8%)	7 (100.0%)	14 (73.7%)	48 (85.7%)	7 (100.0%)	**0.348**
3	28 (84.8%)	7 (100.0%)	14 (73.7%)	44 (78.6%)	6 (85.7%)	**0.566**
4	29 (87.9%)	7 (100.0%)	14 (73.7%)	44 (78.6%)	7 (100.0%)	**0.257**
5	29 (87.9%)	7 (100.0%)	13 (68.4%)	40 (72.7%)	6 (85.7%)	**0.193**
6	30 (90.9%)	7 (100.0%)	14 (73.7%)	43 (78.2%)	7 (100.0%)	**0.163**
7	30 (90.9%)	7 (100.0%)	13 (68.4%)	45 (81.8%)	5 (71.4%)	**0.174**

(continued)

Table 6 (continued)

Items	Informal caregiver (unpaid)	Informal caregiver (paid)	Formal caregiver (Geriatr.)	Formal caregiver (Nurse)	Formal caregiver (Psychol.)	P value
8	30 (90.9%)	7 (100.0%)	13 (68.4%)	43 (78.2%)	6 (85.7%)	**0.182**
9	28 (84.8%)	7 (100.0%)	14 (73.7%)	48 (85.7%)	6 (85.7%)	**0.551**
10	29 (87.9%)	7 (100.0%)	14 (73.7%)	43 (81.1%)	7 (100.0%)	**0.301**
11	26 (78.8%)	7 (100.0%)	14 (73.7%)	36 (66.7%)	7 (100.0%)	**0.139**
12	27 (81.8%)	7 (100.0%)	14 (73.7%)	48 (85.7%)	6 (85.7%)	**0.555**
13	25 (75.8%)	7 (100.0%)	16 (84.2%)	24 (88.9%)	5 (71.4%)	**0.410**
Section C: Support devices						
1	27 (81.8%)	7 (100.0%)	16 (84.2%)	50 (89.3%)	7 (100.0%)	**0.498**
2	30 (90.9%)	7 (100.0%)	16 (84.2%)	45 (80.4%)	7 (100.0%)	**0.344**
3	28 (84.8%)	7 (100.0%)	16 (84.2%)	50 (89.3%)	7 (100.0%)	**0.621**
4	26 (78.8%)	7 (100.0%)	16 (84.2%)	46 (82.1%)	7 (100.0%)	**0.494**
5	26 (78.8%)	7 (100.0%)	16 (84.2%)	43 (76.8%)	7 (100.0%)	**0.367**
6	26 (78.8%)	7 (100.0%)	16 (84.2%)	47 (83.9%)	4 (57.1%)	**0.298**
7	27 (81.8%)	7 (100.0%)	16 (84.2%)	47 (85.5%)	7 (100.0%)	**0.589**
8	27 (81.8%)	7 (100.0%)	16 (84.2%)	47 (83.9%)	7 (100.0%)	**0.588**
Section D: Impact						
1	28 (84.8%)	7 (100.0%)	16 (84.2%)	49 (86.0%)	2 (28.6%)	0.002
2	28 (84.8%)	7 (100.0%)	16 (84.2%)	48 (84.2%)	5 (71.4%)	**0.697**
3	29 (87.9%)	7 (100.0%)	16 (84.2%)	46 (80.7%)	4 (57.1%)	**0.238**
4	29 (87.9%)	7 (100.0%)	16 (84.2%)	47 (82.5%)	7 (100.0%)	**0.549**
5	31 (93.9%)	7 (100.0%)	16 (84.2%)	47 (82.5%)	5 (71.4%)	**0.309**
6	31 (93.9%)	7 (100.0%)	16 (84.2%)	48 (84.2%)	3 (42.9%)	0.010
7	29 (87.9%)	7 (100.0%)	16 (84.2%)	47 (85.5%)	4 (57.1%)	**0.217**

The significative *p*-values (<0.050) should be in bold

Limitations of the present study should also be considered in interpreting our findings. In particular, the differences in educational levels of the caregivers across the three sites of the MARIO Project reflected the caregiving type of each sites: NUIG is a nursing home where the nurses are more numerous and present, IRCCS is an hospital where formal and informal caregivers are present almost in equal measure, and AAB is an association where psychologists and informal caregiver are more present.

Questionnaires similar to the that developed for the MARIO Project were the HOPE Questionnaire developed for the HOPE Project [24] and the AL.TR.U.I.S.M. Questionnaire developed for the AL.TR.U.I.S.M. Project [25]. Regarding the HOPE Project, the caregivers considered that the ICT system could be useful to improve the management of patients with Alzheimer's disease (AD), especially if they are aged 75–84 years and with moderate dementia. Older and low educated caregivers had higher expectations on the potential role of ICT systems in improving the management of AD patients. Regarding the AL.TR.U.I.S.M. Project, the caregivers considered that a Virtual Personal Trainer (VPT) can improve the functional, nutritional, cognitive, affective, neuropsychiatric state, and quality of life of the patients with AD. The caregiver of masculine sex had higher expectations on the potential role of a VPT in improving the management of AD patients.

So the HOPE and AL.TR.U.I.S.M. Questionnaire results seem otherwise than those obtained in our study.

A previous report from the Keeping In Touch Everyday (KITE) Project demonstrated how a user-centered design process involving people with dementia and their relatives/caregivers could lead to the development of devices which are more acceptable and relevant to their needs [26]. Other projects [27–29] did not report data of questionnaires used to evaluate the preferences of caregivers and their dementia patients.

Our analysis represented a point of crucial importance not only in developing and improving the system by taking into considerations the end-users' (both patients and caregivers) expectations and needs, but also in leading to the development of a first prototype and to the experimentation stage as well.

5   Conclusion

The testing stages are still ongoing in order to improve the working patterns of the system and to better integrate all of its elements with particular and always renewed regard to the end-users and their needs, limits and requirements.

This first stage of experimentation activity aimed mainly at drawing clear conclusions on the interaction between the user and the MARIO and in general on the acceptability level of this service robot by the patient.

These data, however, are of great importance since they not only give useful indications to assess what has been accomplished up to now, but also they provide important guidelines in order to improve the system while specific clinical experimentation stages are expected to be carried out over the next months.

The work achieved through a fruitful and continuous interaction among the different subjects involved in the process of development of the system and stakeholders enabled the implementation of a platform which can be further and easily integrated and improved.

Finally, the collected and abovementioned data show a satisfactory integration between the patient and the system along with a great level of acceptability of MARIO by the end-user, both the patients themselves and the caregivers or medical providers, those who, day by day, take care and assist their patients.

Appendix 1: Mario Questionnaire on the Use of Companion Robotics

Section A: Acceptability

1. How Important is that MARIO has a human like appearance?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

2. How important is it that MARIO has a human sounding voice?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

3. How important is it that MARIO has a familiar voice?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

4. How important is it that MARIO has an exterior or covering that people like to touch?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

5. How Important is that MARIO height is adjustable?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

6. How important is it that MARIO can communicate non verbally e.g. smiling or raising eyebrows?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

7. How important is it that MARIO displays emotional expression?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

8. To what extent do you think it likely that your patients would agree to having MARIO for daily assistance in the home to remind them to take medicines, eat and drink, buy food, a tracking mechanism to find easily Important personal objects (keys, teeth, purse or glasses), etc.:

Not at all likely	Slightly likely	Moderately likely	Very likely	Extremely likely

9. To what extent do you think that your patients would agree to having MARIO monitor and track their movements in the house, or outside the house?

Not at all likely	Slightly likely	Moderately likely	Very likely	Extremely likely

10. To what extent do you think that your patients would agree to having MARIO provide entertainment, mind games (e.g. showing pictures of family members), a reminder for favourite TV programmes etc.

Not at all likely	Slightly likely	Moderately likely	Very likely	Extremely likely

11. To what extent do you think that your patients would accept MARIO as to stay connected to and communicate with family, friends and professional caregivers, (e.g. an easy to use touch screen with pictures and names of the family members)?

Not at all likely	Slightly likely	Moderately likely	Very likely	Extremely likely

12. How important is it that the robot can be quiet?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

13. How important is it that the robot takes up no more room than a person while moving about?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

14. How important is it that the robot require internet connection (house without broadband coverage)?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

15. Please rank in order of importance from 1–7 (with 1 being the most Important and 7 being the least important) the features of appearance listed below:

Appearance features	Ranking 1–7
a. Human like appearance	
b. Human sounding voice	
c. Familiar voice	
d. Has an exterior or covering that people like to touch	
e. Adjustable height	

(continued)

Appearance features	Ranking 1–7
f. Displays emotional expression	
g. Communicates non verbally	

Section B: Functionality

1. How important is it that MARIO has face recognition?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

2. How important is it that MARIO has voice recognition?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

3. How important is it that MARIO can distinguish individuals within a group?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

4. How important is it that MARIO has the capacity for natural dialogue?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

5. How important is it that MARIO has a detachable device that can be used outside the house (e.g. GPS function for shopping)?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

6. How Important is it that MARIO can provide prompts for appointments/social events/date and time?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

7. How important is it that MARIO can store and utilise information from a person's life history?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

8. How important is it that MARIO can utilise multimedia to communicate (e.g. read a book, Skype, play music)?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

9. How important is it that MARIO has voice activation?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

10. How important is it that MARIO has gesture recognition?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

11. How important is it that MARIO could help subjects with walking or stand-up?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

12. How important is it that MARIO can understand dialects?

Not at all important	Slightly important	Moderately important	Very important	Extremely important

13. How useful would a detachable device be that allowed MARIO to provide advice and support when you are ou of the house? Eg (GPS function for finding the way to the shops and back home again)

Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful

Section C: Support Devices

To what extent do you think that the following support devices in MARIO could be useful for your patients:

1. Devices for monitoring bed-rest and movements of your patient, such as integrated video/sound systems and imbalance sensors, inside of his/her home to reduce the risk of falls	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful
2. Devices for monitoring the medication use, such as pill dispenser and/or time schedule reminder system, to avoid errors in drug use by your patients	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful
3. Devices for monitoring the ambient environmental conditions, (i.e. security systems to control temperature, gas-smoke, lights, humidity, entrance-exits of main doors etc.) to improve the safety and wellness of your patients	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful
4. Devices for regulating heating, humidity, lighting, TV channel	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful
5. Devices for undertaking comprehensive geriatric assessment	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful
6. Devices that link to care planning	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful
7. Devices for monitoring physiological deterioration	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful
8. Devices for monitoring cognitive deterioration	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful

Section D: Impact of Mario

To what extent do you think MARIO could be useful in order to:	
1. Improve the quality of life of your patients	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful
2. Improve the quality of care that you provide to your patients	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful
3. Improve the safety in the daily living activities of your patients	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful
4. Carry out emergency communication/alert messages	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful
5. Improve the care provided; home-based physical and/or cognitive rehabilitation programs of your patients	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful
6. Detect when a person is becoming more lonely and isolated	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful
7. Detect health status changes	☐ Not useful at all ☐ YES, low level of usefulness ☐ YES, moderately useful ☐ YES, very useful

8. What other functions do you think MARIO should have to increase independent living for your patients?

_____

_____

_____

_____

DEMOGRAPHICS

Please tick (√) the appropriate box as indicated

Gender:

Male   ☐

Female   ☐

Current Occupation: _____

Please indicate the highest level of education attained:

No Formal education   ☐   Primary Education   ☐

Secondary   ☐   Post leaving Cert   ☐

Third Level- Non Degree   ☐

Technical/Vocational Qualification ☐   Please Specify_____

Third Level- Degree or above   ☐   Please Specify_____

Professional Qualification   ☐   Please Specify_____

Other   ☐   Please Specify_____

References

1. Prince M, Jackson J (2009) Alzheimer's disease international. World Alzheimer report. http://www.alz.co.uk/research/worldreport/ (Advance access published May 2016)
2. Murphy K, Casey D (2015) http://www.alzheimer-europe.org/Conferences/Previous-conferences/2015-Ljubljana/Detailed-programme-abstracts-and-presentations/PO1-Dementia-Friendly-Society (Advance Access published May 2016)
3. Holt-Lunstad J, Smith TB, Layton JB (2010) Social relationships and mortality risk: a meta-analytic review. PLoS Med 7(7):e1000316
4. Steptoe A, Shankar A, Demakakos P, Wardle J (2013) Social isolation, loneliness and all-cause mortality in older men and women. In: Proceedings of the national academy of sciences of the USA (PNAS), 10.1073/pnas.1219686110. 25 Mar 2013
5. O'Shea E (2007) Implementing policy for dementia care in Ireland. The time for action is now. In Irish Centre for Social Gerontology, National University of Ireland, Galway
6. Norris FH, Stevens SP, Pfefferbaum B, Wyche KF, Pfefferbaum RL (2008) Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. Am J Community Psychol 41:127–150
7. http://www.mario-project.eu/portal/
8. Pilotto A, Ferrucci L, Franceschi M, D'Ambrosio LP, Scarcelli C, Cascavilla L, Paris F, Placentino G, Seripa D, Dallapiccola B, Leandro G (2008) Development and validation of a multidimensional prognostic index for 1-year mortality from the comprehensive geriatric assessment in hospitalized older patients. Rejuvenation Res 11:151–161
9. Schulz R, Martire L (2004) Family caregiving of persons with dementia: prevalence, health effects and support strategies. Am J Geriatr Psychiatry 12:240–249
10. Gaugler JE, Kane RA, Langlois J (2000) Assessment of family caregivers of older adults. In: Kane RL, Kane RA (eds) Assessing older persons: measures, meaning and practical applications. Oxford University Press, New York, pp 320–359
11. Gaugler JE, Davey A, Pearlin LI, Zarit SH (2000) Modeling caregiver adaptation over time: the longitudinal impact of behavior problems. Psychol Aging 15:437–450
12. Jönsson L, Wimo A (2009) The cost of dementia in Europe: a review of the evidence and methodological considerations. Pharmacoeconomics 27(5):391–403
13. Schulz R, O'Brien AT, Bookwala J, Fleissner K (1995) Psychiatric and physical morbidity effects of dementia caregiving: prevalence, correlates, and causes. Gerontologist 35:771–791
14. Mahoney R, Regan C, Katona C, Livingston G (2005) Anxiety and depression in family caregivers of people with Alzheimer disease: the LASER-AD study. Am J Geriatr Psychiatry 13:795–801
15. Clipp EC, George LK (1990) Psychotropic drug use among caregivers of patients with dementia. J Am Geriatr Soc 38:227–235
16. Vitaliano PP, Zhang J, Scanlan JM (2003) Is caregiving hazardous to one's physical health? A meta-analysis. Psychol Bull 129:946–972
17. Son J, Erno A, Shea DG, Femia EE, Zarit SH, Stephens MA (2007) The caregiver stress process and health outcomes. J Aging Health 19:871–887
18. Schulz R, Beach SR (1999) Caregiving as a risk factor for mortality: the Caregiver health effects study. JAMA 282:2215–2219
19. König A, Aalten P, Verhey F, Bensadoun G, Petit PD, Robert P et al (2014) A review of current information and communication technologies: can they be used to assess apathy? Int J Geriatr Psychiatry 29:345–358
20. D'Onofrio G, Sancarlo D, Ricciardi F, Ruan Q, Yu Z, Giuliani F, Greco A (2016) Cognitive stimulation and information-communication technologies (ICT) in Alzheimer's disease: a systematic review. In: Garza P (ed) Cognitive control: development, assessment and performance. https://www.novapublishers.com/catalog/product_info.php?products_id=58756. Nova Science

21. McKenzie B, Bowen ME, Keys K, Bulat T (2013) Safe home program: a suite of technologies to support extended home care of persons with dementia. Am J Alzheimers Dis Other Demen 28(4):348–354
22. Espie CA, Kyle SD, Williams C, Ong JC, Douglas NJ, Hames P et al (2012) A randomized, placebo-controlled trial of online cognitive behavioral therapy for chronic insomnia disorder delivered via an automated media-rich web application. Sleep 35(6):769–781
23. McKhann GM, Knopman DS, Chertkow H, Hyman BT, Jack CR Jr, Kawas CH et al (2011) The diagnosis of dementia due to Alzheimer's disease: recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. Alzheimers Dement 7:263–269
24. Pilotto A, D'Onofrio G, Benelli E, Zanesco A, Cabello A, Margelí MC, Wanche-Politis S, Seferis K, Sancarlo D, Kilias D (2011) Information and communication technology systems to improve quality of life and safety of Alzheimer's disease patients: a multicenter international survey. J Alzheimers Dis 23(1):131–141
25. Caroppo A, Leone A, Siciliano P, Sancarlo D, D'Onofrio G, Giuliani F et al (2014) Cognitive home rehabilitation in Alzheimer's disease patients by a virtual personal trainer. Ambient assisted living, pp 147–155
26. Robinson L, Brittain K, Lindsay S, Jackson D, Olivier P (2009) Keeping In Touch Everyday (KITE) project: developing assistive technologies with people with dementia and their carers to promote independence. Int Psychogeriatr 21:494–502
27. Duff P, Dolphin C (2007) Cost-benefit analysis of assistive technology to support independence for people with dementia—Part 1: development of a methodological approach to the ENABLE cost-benefit analysis. Technol Disabil 19:73–78
28. Duff P, Dolphin C (2009) Cost-benefit analysis of assistive technology to support independence for people with dementia—Part 2: results from employing the ENABLE cost-benefit model in practice. Technol Disabil 19:79–90
29. Virone G, Sixsmith A (2008) Monitoring activity patterns and trends of older adults. Conf Proc IEEE Eng Med Biol Soc 2008:2071–2074