

# Differences in Functionality Between Independent, Slight, and Moderate Dependent Older Adults: A Cross-sectional Study

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## Research Article

**Keywords:** Older adults, functional capacity, cognitive capacity, quality of life, multidimensional intervention. Barthel Index, EQ-5D, health status, depression

**Posted Date:** April 9th, 2021

**DOI:** <https://doi.org/10.21203/rs.3.rs-322457/v1>

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1 **Differences in functionality between independent, slight, and moderate dependent**  
2 **older adults: a cross-sectional study**

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27 **Abstract**

28 **Background:** Aging is a gradual process characterized by damage to the physiological  
29 functions that frequently lead to dependence in the older adults of 60 years or older. We  
30 hypothesize significant differences in mental and physical capacity between fully  
31 independent older adults and slight to moderate dependent older adults.

32 **Method:** A cross-sectional analysis of 322 older adults of 60 years or more, with a Barthel  
33 Index equal to or higher than 60, who attended day centers during August 2018 in Santiago-  
34 Chile was used. Quality of life, physical ability, cognitive capacity, and symptoms of  
35 depression of fully independent with slight to moderate dependent older adults are  
36 compared.

37 **Results:** A higher proportion of older adults with complete independence have higher levels  
38 of quality of life and mobility. Even a small reduction in independence has a significant  
39 reduction in quality of life. An increase from a 60-90 score to a 91-99 score in the Barthel  
40 Index rises 42% [CI95% 18-66] the EQ-5D score, this difference increases to 49% [CI95%  
41 29-70] for full independence. Climbing stairs and incontinence in urination are the two main  
42 activities related to having a lower independence level (lower than 100 Barthel Index score).  
43 Ambulation and climbing stairs are the two main activities related with lower than the cutoff  
44 levels of normality for quality of life (EQ5D) and physical condition (TUG). Finally, urine and  
45 bowel incontinence, and lower levels of ambulation are the main activities related with  
46 symptoms of depression (Yesavage score).

47 **Conclusion:** There were significant differences in health-related measures among different  
48 levels of independent older adults. Understanding the potential causes of these differences  
49 could help prioritize the focus of multidimensional programs on health and prevention with  
50 the aim of prolonging older adults' state of independence and improving their quality of life.

51

52

53 **Key Words:** Older adults, functional capacity, cognitive capacity, quality of life,  
54 multidimensional intervention. Barthel Index, EQ-5D, health status, depression.

55

## 56 **Introduction**

57 Aging is a gradual, long-standing, heterogeneous process characterized by progressive and  
58 cumulative damage to physiological functions (1), leading to dependency in older adults.  
59 Loss of functional capacity of older adults is determined by the loss of intrinsic capacity,  
60 related to physical and mental capacity and external factors, such as environmental, poverty  
61 and low education levels. Also, abilities are affected by factors related to each person's  
62 lifestyle (e.g. sedentarism, nutrition) (2).

63

64 Globally, there were over 703 million older adults over 65 years old in 2019, with at least  
65 9.1-9.4% of them that live under extreme poverty (3). It is projected that there will be 1.5  
66 billion older people by 2050 (4). This demographic change has been drastic due to the  
67 increase in life expectancy and low global fertility rates. Chile has not been aliened to this  
68 process, according to the 2017 census the population aged 60 and over reached 16.2% (5),  
69 which in number of people means over 2.8 million older adults. It is estimated that 24% of  
70 older adults have some degree of dependency, up to severe dependency, as they become  
71 older (76% or 2.1 million of those older adults in Chile, therefore, are considered  
72 independent) and sixty seven percent of them are afraid of losing their independence (6).  
73 This dependency is even more common for older adults belonging to lower socioeconomic  
74 levels (7–9), considering that 67% of older adults in Chile are afraid of losing their  
75 independence (6).

76

77 Loss of functional capacity leads to dependency which is marked by the need for older adults  
78 to use third parties to carry out the basic and instrumental activities of daily life (ADL), such  
79 as walking or dressing (7). However, there is no knowledge about the most important  
80 determinants and factors that relate with the loss of functionality in older adults.

81

82 As an initial process, 322 older adults were selected and measured on their dependency  
83 levels using the Barthel Index along with sociodemographic background, health measures,  
84 cognitive capacities, and physical capacities.

85

86 Herein we examine whether there are significant differences among three levels of  
87 dependency (moderate dependency, slight dependency, and independence; measured with  
88 the Barthel Index ((10))<sup>1</sup>) in older adults who attend these day centers, and whether  
89 anthropometric measures, health status, physical capacity, cognitive decline, symptoms of  
90 depression, urine and bowel incontinence, and quality of life have a relationship among  
91 these three levels of dependency.

92

## 93 **Material and Method**

94

### 95 *Design and study population*

96

97 A cross-sectional, observational, and descriptive study was conducted. The population that  
98 participated in this study met the following inclusion criteria: i) people 60 years of age or

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<sup>1</sup> The Barthel Index was designed to assess the level of dependency according to 10 activities of daily living (ADL) in institutionalized patients (10). Given its easy application and its good psychometric capabilities, this index has expanded its application to other contexts such as ambulatory rehabilitation units or for older adults living in the community (11). Within this framework, 5 cut-off points were proposed by Shah to differentiate self-reliant people from dependents: total dependency: 0-20; severe dependency: 21-60; moderate dependency: 61-90; slight dependency: 91-99; Independence: 100, considering that people with values over 60 points are practically independent regarding their basic skills (12).

99 older, ii) socially vulnerable (older adults who belong to 60% of the Chilean population with  
100 less income or greater vulnerability, according to the registry social of homes) iii) residents  
101 of the district of Puente Alto in Santiago, Chile, who were attending community elderly day  
102 centers during August of 2018 (program that integrates older adults during the day, holding  
103 a series of workshops that affect the personal, social and community sphere), iv) those who  
104 have accepted and signed the informed consent according to current regulations and v)  
105 those with a slight dependency or independent, whose Barthel Index was 60 to 100 points.  
106 Older adults that according to the primary care center that either had functional or health  
107 difficulties that would not allow them to participate in the intervention (e.g. Alzheimer or other  
108 dementias), or that had evident cognitive deterioration that would not allow them to  
109 understand the consent form, were excluded. Of the total of 528 people attending all the day  
110 centers studied, 61% met the inclusion criteria (n = 322 older adults). All participants were  
111 completed on their dependency and functionality levels.

112

113 *Level of dependency:*

114

115 To measure older adults independence and their ability to carry out activities of daily life  
116 (ADL) considered as basic (10), the Barthel Index was used. This instrument generates a  
117 score between 0 to 100 points that estimates the degree of independence of the person. A  
118 score of 100 corresponds to a totally independent person, while a score of 0 is a person with  
119 absolute dependence.

120

121 *Functionality tests:*

122

123 The EQ-5D Index is based on five dimensions: mobility, personal care, habitual activity,  
124 pain/discomfort and anxiety/depression<sup>2</sup>. The instrument generates combinations of  
125 responses that form 243 possible profiles of health states, assigning to each profile a score  
126 that ranges from -0.494 to 1, where 0 is a state of dead health, 1 is a state of perfect health  
127 and values less than 0 indicate worse states than being dead (14). A score of 0.457 or above  
128 indicates a positive quality of life perception (14). To measure the fear of falling in older  
129 adults, the Short FES I (Falls Efficacy Scale) questionnaire was used. This instrument  
130 consists of 7 questions, each of them has four response categories, totaling 28 points<sup>3</sup>.

131

132 To measure physical condition, 3 instruments were used. Time Up-And-Go test (TUG), Five  
133 times Sit to Stand test (TSS), and Self-selected walking speed (WST). TUG measures the  
134 balance and mobility as the time between standing up, walk 3 meters, and sit down again of  
135 older adults. It consists of getting up, walking 3 meters and sitting down again. A person  
136 who takes more than 10 seconds to develop this test is considered to have impaired mobility  
137 (17). Five times Sit to Stand test asks older adults to stand and sit in a chair 5 times,  
138 recording the time it takes to develop the test. It evaluates the muscular strength of the lower  
139 limbs and it is considered that if the person takes 12 seconds or more to finish the test, then  
140 they have strength problems in their legs (18). The self-selected walking speed test asks  
141 older adults to walk at a normal pace 6 meters, allowing the speed of walking to be  
142 evaluated. If it travels less than 0.8 meters / second it means that it has some disorder in its  
143 walking capacity (19).

144

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<sup>2</sup> Each question is evaluated according to three possible answers; 1 = without problems, 2 = with moderate problems and 3 = with severe problems (13).

<sup>3</sup> Delbaere and collaborators established cut-off points to classify the risk of falls into: low, moderate and high risk, with scores of 7-8, 9-13 and 14-28 respectively (15,16).

145 To detect cognitive impairment, the Memory Impairment Screen (MIS) instrument was used  
146 (20). This instrument asks older adults to memorize 4 words from different semantic  
147 categories. After 2-3 minutes they are asked to repeat them; 2 points are awarded for each  
148 word remembered spontaneously and 1 point is awarded for each word remembered with  
149 help. The score ranges from 0 to 8. A score of 5 points and less suggests cognitive decline  
150 (21), and to detect symptoms of depression, the abbreviated Yesavage Index was used<sup>4</sup>. A  
151 score of 2 or more positive responses suggests depression (23).

152

153 Finally, to determine their sociodemographic level, we observed and measured for each  
154 older adult, their gender, age, marital status, schooling, literacy, and whether they lived  
155 alone or accompanied. And to determine their health status, we measured through a self-  
156 answered questionnaire, their history of smoking, medication consumption, calf  
157 circumference as an indicator of risk of malnutrition (24,25), number of diseases at the  
158 moment as a measure of comorbidity, and body mass index (BMI kg / mts<sup>2</sup>) as an indicator  
159 of nutritional status (26).

160

#### 161 *Data registration procedure*

162

163 The data capture was done in REDCap (27), a software that operates in web browsers and  
164 that allows the online construction and management of the database. The data was collected  
165 through different surveys that consolidated all the variables and instruments described  
166 above.

167

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<sup>4</sup> The 5-item version was found to be as effective as the 15-question version and even more so when applied on a population scale, with a sensitivity of 97% and a specificity of 85% for the diagnosis of depression (22). In Chile it proved to be effective as a screening instrument, with good sensitivity, specificity, and positive and negative predictive values.

168 The surveys were applied by trained personnel through workshops that included the  
169 explanation of the content of the instruments, their measurement and a demonstration of the  
170 operation of the data capture software. Subsequently, a role play was carried out where the  
171 interviewers exercised the application of the instrument among themselves, thus being able  
172 to practice and solve their questions.

173

#### 174 *Analysis of Data*

175

176 Older adults were classified into 3 groups according to the Barthel Index as proposed by  
177 Shah: independent (score 100 points), moderate dependency (91 to 99 points), and slight  
178 dependency (60 to 90 points) (12). These 3 groups were then classified by age, gender,  
179 education level, literacy, whether living alone or accompanied, marital status, number of  
180 comorbidities, and BMI. Table 1 presents the frequencies, percentages per group and test  
181 of proportions<sup>5</sup>. All the analysis was done at 95% statistical confidence.

182

183 Each older adult was classified with either independent Barthel Index (100 score) or slight  
184 to moderate dependency Barthel Index (60 to 99 score) to establish which of the 10 Barthel  
185 activities were the most important ones which determine the final Barthel Index.

186 To examine the impact of dependency on quality of life, a multivariate linear regression was  
187 conducted to predict quality of life (EQ5D score) from changes between moderate  
188 dependency, slight dependency, and independence controlling for all the socio-  
189 demographic and health variable we were able to observe (age, gender, education, civil  
190 status, live alone, number of comorbidities, and BMI):

191

---

<sup>5</sup> All the analyses were performed in the R software, version 4.0.3 (28).

192 
$$\ln(EQ5D_i) = \alpha_i + \beta_{1i}Barthel_i + \beta_{ci}Controls_i + \varepsilon_i$$

193

194 Where,  $Barthel_i$  represents 3 dummy variables. One where the observation is equal to 1 if  
195 subject  $i$  had a score between 91 and 99, and zero otherwise; the second equal to 1 if subject  
196  $i$  had a score equal to 100, and zero otherwise;  $Controls_i$  represents each of the  
197 demographic and health variables observed for subject  $i$ , and  $\varepsilon_i$  is the error term.

198

199 Finally, Barthel activities were cross tabulated above or below the cutoff level of normality  
200 for EQ-5D, TUG, and Yesavage scores. They were analyzed according to how many  
201 participants were above each cutoff level for the Barthel Index groups.

202

### 203 *Ethical Considerations*

204

205 The project and the informed consent were reviewed and approved by the Scientific Ethics  
206 Committee of the Universidad de los Andes, Santiago - Chile, Code CEC201866, from  
207 October-2018, according to current Chilean regulations (Law 20 120) (29).

208

209 Before starting the measurements and carrying out the surveys, a general meeting was held  
210 to explain the objectives of the study and later the senior citizens were informed about these  
211 objectives, the measurements, the benefits, the possible risks, and above all the willingness  
212 to participate. After that, each person signed the informed consent. The identity of the  
213 participants was protected by encrypting sensitive data and limiting access to Protected  
214 Health Information.

215

### 216 **Results**

217

218 Participants were evaluated using all the tests and indicators. Out of the total older adults,  
219 322 participants fulfilled all the requisites of eligibility. 73 or 23% of all older adults were  
220 classified as moderate dependent, 76 or 24% of all older adults as slight dependent, and  
221 173 (53% of all older adults) as independent. 60% of the participants were between 60 and  
222 74 years old, most of them were female (75%) and lived with someone else (68%). Also,  
223 most the participants had at least 3 diseases (59%).

224

225 Through tests of equality of proportions (test whether the three groups of older adults  
226 classified by Barthel Index have the same proportions or not), it was determined that among  
227 all sociodemographic and health measures, there were statistical differences in dependency  
228 classification for older adults living alone.

229

230 A high proportion of independent older adults have also high levels of quality of life (EQ5D),  
231 better performance in mobility tests, lower levels of fear of falling, and lower levels of  
232 symptoms of depression. The biggest differences between no dependence and moderate  
233 dependence were for quality of life and mobility. From all older adults classified as moderate  
234 dependency (73 older adults), 44 of them or 60% were classified with low quality of life with  
235 EQ-5D score of less than 0.457. In contrast, from all older adults classified as independent  
236 (173 older adults), only 24 or 14% were found to have low quality of life. For TUG score,  
237 there were also a difference of 46% between independence and moderate dependence  
238 groups: 69% of all dependent older adults were found to take more than 10 seconds to get  
239 up and go, but only 23% of independent older adults were found to take more than 10  
240 second. From all the scores estimated, the MIS score and Five Sit to Stand test score were  
241 the only ones that were not significantly different between dependency groups. See Table 1  
242 and Figure 1 below for these differences.

243  
 244  
 245  
 246  
 247  
 248  
 249  
 250

**Table 1. Physical and cognitive evaluations of older adults according to Barthel Index groups**

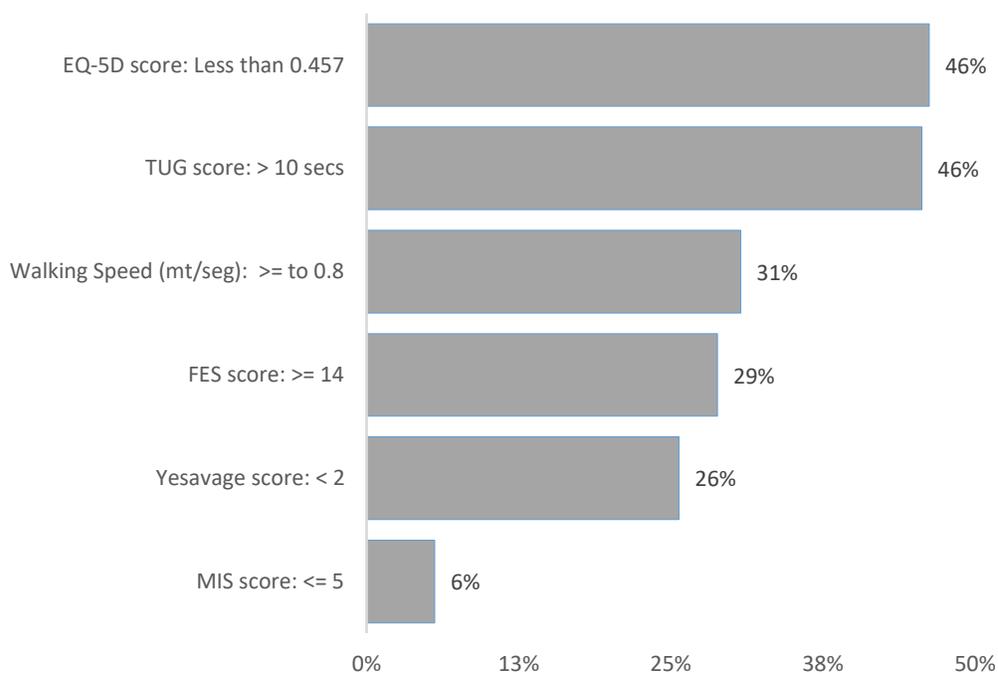
Physical and cognitive evaluation	Barthel Index				p-value
	60-90 (N=73)		91-99 (N=76)		
<b>EQ5-D (score)</b>					
Less than 0.457	44 (60%)	20 (27%)	24 (14%)		<0.001***
More than or equal to 0.457	29 (40%)	54 (73%)	147 (86%)		
<b>TUG (score)</b>					
Less than 10	22 (31%)	43 (57%)	131 (77%)		<0.001***
More than or equal to 10	48 (69%)	32 (43%)	39 (23%)		
<b>Walking Speed (mt/sec)</b>					
More than or equal to 0.8	22 (37%)	11 (15%)	10 (6%)		<0.001***
Less than 0.8	38 (63%)	64 (85%)	159 (94%)		
<b>Five Sit To Stand (secs)</b>					
More than or equal to 12	63 (90%)	64 (85%)	134 (79%)		0.111
Less than 12	7 (10%)	11 (15%)	35 (21%)		
<b>FES (score)</b>					
More than or equal to 14	33 (46%)	27 (36%)	30 (18%)		<0.001***
Less than 14	38 (54%)	48 (64%)	140 (82%)		
<b>Yesavage (score)</b>					

Less than 2	44 (62%)	56 (75%)	149 (88%)	<0.001***
More than or equal to 2	27 (38%)	19 (25%)	21 (12%)	
<b>MIS (score)</b>				
More than 5	63 (86%)	70 (92%)	159 (92%)	0.342
Less than or equal to 5	10 (14%)	6 (8%)	14 (8%)	

251

252 \* According to the categorization of the Barthel Index. Not necessarily each characteristic adds up to the total

253 Older adults since some of these were not evaluated in their entirety.



254

255 **Figure 1. Difference between percentages of Barthel moderate dependence (60-90)**  
 256 **and independence (100) for each score.**

257 *Note:* The percentage for each score is calculated taking the difference between the percentage of older adults  
 258 classified as independent and moderate dependency. For example, for EQ-5D score, 60% of all older adults  
 259 were either slight or moderate dependent (less than 0.457 points in the EQ-5D test) and 14% of all older adults  
 260 were independence (higher than 0.457 points in the EQ-5D test). The difference of 46% is reflected in this Figure.

261

262 Even a small reduction in dependency had a significant increase in health-related quality of  
 263 life. An increase from a 60-90 score (referential group) to a 91-99 score in the Barthel Index  
 264 rises 42% [CI95% 18-66] the EQ-5D score and 49% [CI95% 29-70] for full independence.  
 265 Table 2 shows the coefficients from the multivariate linear regression and Figure 2 presents  
 266 a graphical representation of the difference in distribution between the three Barthel groups  
 267 for EQ-5D score. The regression coefficients for the Barthel Index are interpreted as the  
 268 difference in percentages between a Barthel Index lower or equal than 90 (moderate  
 269 dependency) and either Barthel Index of 91 to 99 (slight dependency) or Barthel Index equal  
 270 to 100 (independence).

**Table 2. Multivariate Linear Regression between quality of life (EQ-5D) and dependency groups (Barthel Index)**

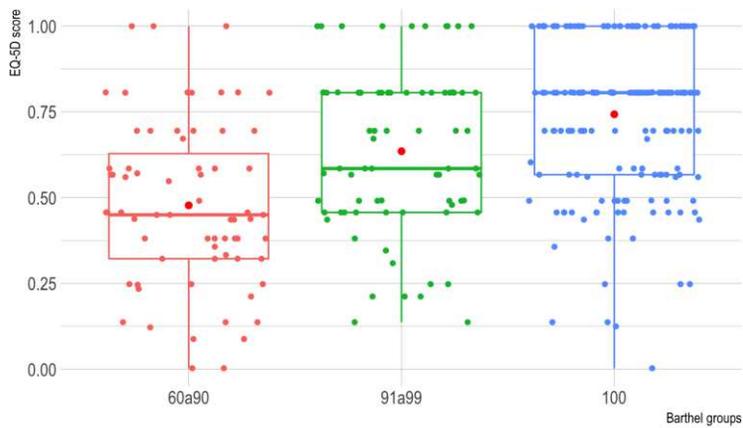
Independent variable:					
Ln (EQ5D)					
	Coefficient	Std. Error	t value	Pr(> t )	CI (95%)
Constant	-0.99	0.7	-1.399	0.16	[-2.37, 040]
Barthel Index score = 91 to 99	0.42	0.12	3.508	0.00***	[0.18, 0.66]
Barthel Index score = 100	0.49	0.1	4.713	0.00***	[0.29, 0.70]
Controls: Age, gender, educational level, civil status, live alone, comorbidity, and BMI					
R-square	0.12				
Observations	292				

Note: p-value < 0.01 \*\*\*; p-value < 0.05 \*\*; p-value < 0.1 \*

Referential group: Barthel Index score = 60-90 (moderate dependency)

272

273



274

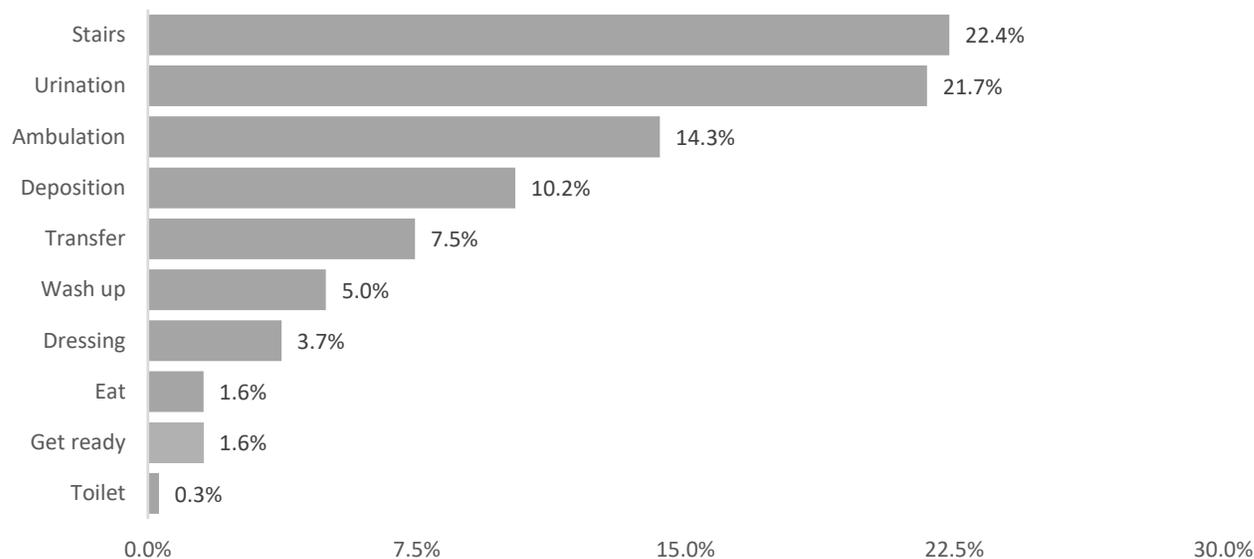
275 **Figure 2. Boxplot of EQ-5D score for the 322 older adults clustered by group of**  
276 **dependency.**

277 *Note:* The red dot in each box represents the mean value for that group.

278

279 Climbing stairs and incontinence in urination are the two main activities related to having  
280 some dependence (slight to moderate dependence with Barthel Index lower than 100  
281 points). Figure 3 presents the percentage differences per Barthel activity. We estimated the  
282 percentage of older adults who had a lower than the maximum score for each of the Barthel  
283 activities and we observe that 22.4% of all older adults have lower score than the maximum  
284 due to a deficit in climbing stairs and 21.7% of all older adults have lower score than the  
285 maximum for incontinence. The other activities show not significantly difference between the  
286 proportions.

287



288

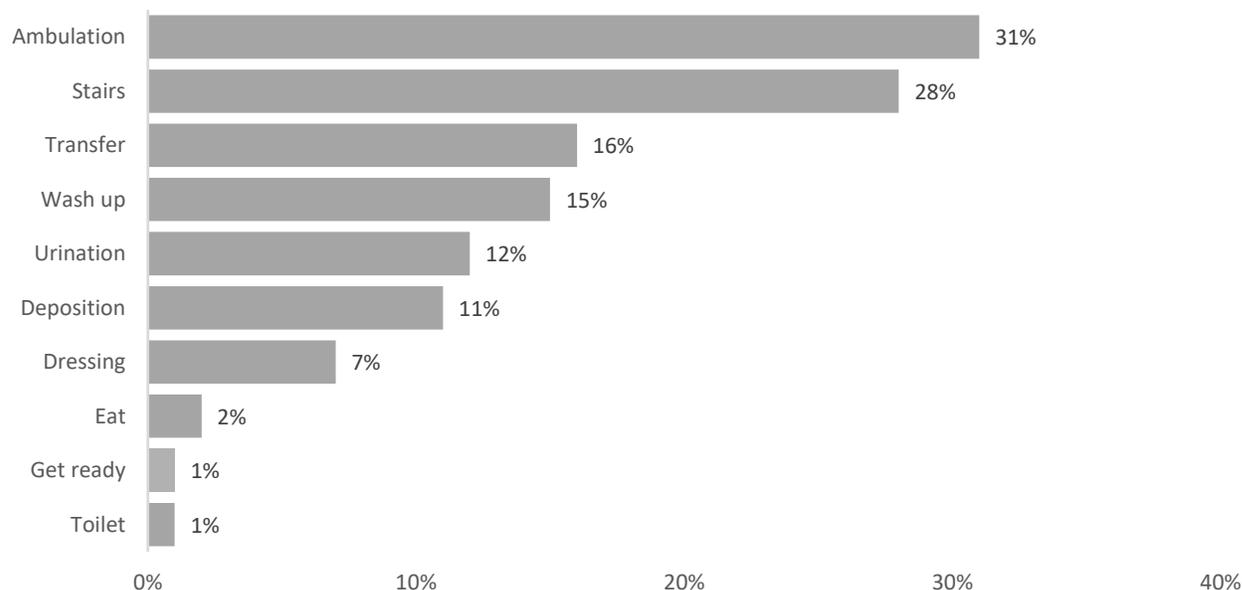
289 **Figure 3: Percentage of older adults with Barthel Index less than maximum score**  
 290 **per activity.**

291 *Note:* (a) Each percentage per activity was calculated by as the number of older adults with a score lower than  
 292 the maximum score for that activity divided by the 322 older adults. For example, for climbing stairs, 72 out of  
 293 the 322 older adults scored less than 10 points (max score). (b) \*\*\* test of proportions p-value < 0.05.

294

295 Ambulation and climbing stairs are the two main activities related with lower than the cutoff  
 296 levels for quality of life (EQ-5D) and physical condition (TUG). Figure 4 presents the  
 297 percentage differences for EQ-5D and Barthel index. When Barthel activities were analyze  
 298 one by one, it was observed that activities related with movement like ambulation, climbing  
 299 stairs, transfer from one place to another have a higher difference on how older adults  
 300 scored in terms of quality of life or physical condition.

301



302

303 **Figure 4. Difference between percentage of older adults over and under 0.457 EQ-5D**  
 304 **scores by Barthel activity.**

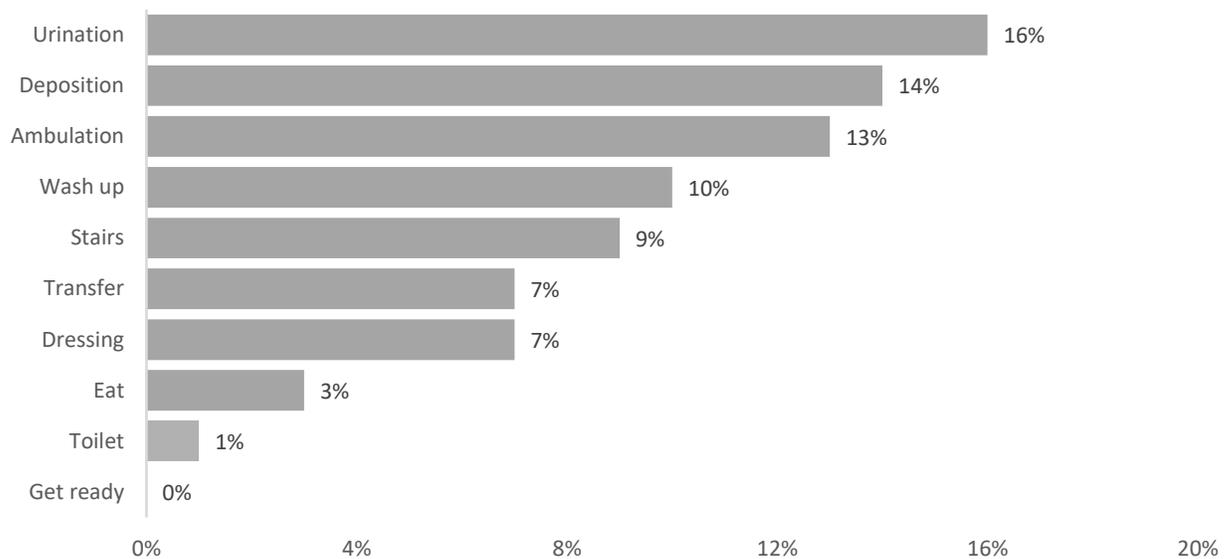
305 *Notes:* (a) The percentage for each activity is calculated taking the difference between the percentage of older  
 306 adults classified above or below the EQ-5D cutoff score of 0.457 for all older adults classified with maximum  
 307 score for that activity. For example, for ambulation, 93% of all older adults with a higher score than 0.457  
 308 points in the EQ-5D test scored also the maximum score for ambulation in the Barthel Index, but only 63% of  
 309 all older adults with a lower score than 0.457 points in the EQ-5D test scored also the maximum for ambulation  
 310 in the Barthel Index. The difference of 31% is reflected in this Figure. (b) \*\*\* test of proportions p-value < 0.05.

311

312 Urine and bowel incontinence, and ambulation are the three main activities related with  
 313 levels of depression symptoms (Yesavage score). These activities had the most significant  
 314 difference between moderate dependence and independence in how older adults scored in  
 315 the Yesavage test. Compared with quality of life and physical condition, the differences in  
 316 activities with respect to Yesavage were smaller. Figure 5 presents the percentages  
 317 differences for Yesavage and Barthel index.

318

319



320

321

322 **Figure 5. Difference between percentage of older adults over and under 2 points for**  
 323 **the Yesavage score by Barthel activity.**

324 *Note:* (a) The percentage for each activity is calculated taking the difference between the percentage of older  
 325 adults classified above or below the Yesavage cutoff score of normality (score of 2) for all older adults  
 326 classified with maximum score for that activity. For example, for incontinence of urination 82% of all older  
 327 adults with a lower than 2 points in the Yesavage test scored the maximum for incontinence of urination in the  
 328 Barthel Index, but only 66% of all older adults with a higher score than 2 points in the Yesavage test scored  
 329 also the maximum for incontinence of urination in the Barthel Index. The difference of 16% between these two  
 330 percentages is reflected in this Figure. (b) \*\*\* test of proportions p-value < 0.05.

331

332 Finally, gender, education level, literacy, number of comorbidities, memory score (MIS), and  
 333 civil status do not show a significant relationship with proportion of older adults in either  
 334 independence (100 score in Barthel) or moderate/slight dependence (less than 100 score in  
 335 Barthel). For older adults living alone, there is a significant difference in proportions between  
 336 dependencies where older adults with no dependency tend to live alone more frequently.  
 337 For example, only 19% of older adults with moderate dependence were living alone  
 338 compared with 33% of all older adults with no dependence. Table 3 presents the

339 classification of all older adults by socio-demographic and health variables observed by  
 340 Barthel group.  
 341

**Table 3. Socio-demographic and anthropometric characteristics of the older adults by Barthel group**

Variable	Barthel Index						p-value
	60-90 (N= 73)		91-99 (N=76)		100 (N=173)		
<b>Age (years)</b>							
60 -74	38	(52%)	43	(57%)	112	(65%)	0.142
75 or more	35	(48%)	33	(43%)	61	(35%)	
<b>Gender</b>							
Feminine	58	(79%)	62	(82%)	120	(69%)	0.069*
Masculine	15	(21%)	14	(18%)	53	(31%)	
<b>Live Alone</b>							
Yes	14	(19%)	31	(41%)	57	(33%)	0.016**
No	59	(81%)	45	(59%)	116	(67%)	
<b>Educational Level</b>							
No studies	2	(3%)	0	(0%)	1	(1%)	0.720
Preschool	0	(0%)	0	(0%)	1	(1%)	
Primary incomplete	22	(32%)	21	(29%)	43	(27%)	
Primary complete	16	(23%)	18	(25%)	35	(22%)	
Secondary incomplete	13	(19%)	15	(21%)	39	(24%)	
Secondary complete	13	(19%)	13	(18%)	28	(17%)	
Technical complete	3	(4%)	3	(4%)	9	(6%)	
Higher education	0	(0%)	2	(3%)	5	(3%)	
<b>Literate</b>							

Yes	69	(95%)	72	(95%)	161	(93%)	0.843	
No	4	(5%)	4	(5%)	12	(7%)		
<b>Marital Status</b>								
Married	34	(47%)	35	(46%)	81	(47%)	0.994	
Widowed	24	(33%)	21	(28%)	33	(19%)		
Single	10	(14%)	10	(13%)	35	(20%)		
Separated	3	(4%)	8	(11%)	13	(8%)		
Divorced	1	(1%)	1	(1%)	9	(5%)		
Cohabit	1	(1%)	1	(1%)	2	(1%)		
<b>BMI</b>								
Emaciated	7	(10%)	7	(9%)	11	(6%)		0.430
Normal	15	(21%)	23	(31%)	71	(42%)		
Overweight	26	(36%)	21	(28%)	47	(27%)		
Obese	25	(34%)	23	(31%)	42	(25%)		
<b>Comorbidities</b>								
More than or equal to 3	48	(66%)	49	(64%)	94	(54%)	0.144	
Less than 3	25	(34%)	27	(36%)	79	(46%)		

342

343

344

## 345 Discussion

346

347 One of the most important concerns for older adults is losing their independence; 67% of all  
 348 older adults surveyed in Chile expressed this opinion in the V Encuesta Nacional de Calidad  
 349 de Vida en la Vejez in 2019 (6). Activities of daily living (ADL) allow older adults more or less  
 350 independence which is closely related to functionality, that is, having the physical and / or

351 mental capacity to perform ADLs. Barthel is currently considered a relevant instrument to  
352 identify the deterioration of the first ADLs in older adults during the natural aging process. It  
353 is a long-standing instrument, recognized in its application in dependent and institutionalized  
354 people, which allows determining the state of dependency.

355

356 Through this study, carried out on 322 older adults aged 60 and over who attend day centers  
357 in Santiago, Chile, we have been able to associate the categories of the Barthel Index with  
358 quality of life, cognitive capacity and functional activities of the participants. Using cut-off  
359 points from the literature to distinguish normality in the measurements, we observe the  
360 usefulness of the Barthel Index in an independent population.

361

362 The categorization provided by Barthel allows to identify some of the activities that are  
363 associated with slight levels of dependency, and these may be predictors of functional  
364 deterioration. Although, people with a slight loss of functionality are still considered highly  
365 independent according to the Barthel Index, this study provides evidence such as how  
366 independence is related with high levels of quality of life (EQ-5D) and mobility (especially  
367 inside the house), and how quality of life raises significantly among independent older adults  
368 compared with older adults who are slight or moderate dependent. It also provides evidence  
369 on how climbing stairs and urine incontinence are some of functions of daily life that  
370 deteriorate even when older adults are considered independent, and how the deterioration  
371 of these functions together with incontinence of depositions are related with symptoms of  
372 depression.

373

374 These differences in activities and how they associate with dependency are very important  
375 if one's goal is to increase older adults' quality of life and reduce symptoms of depression.  
376 For example, urine incontinence has a negative impact in quality of life, self-esteem, and

377 social interaction of older adults which it is turned into incapacity to work and depression  
378 (30).

379

380 Multidimensional programs that target older adults that could detect and target earlier loss  
381 of functionality and help them increase mobility and reduce incontinence in urination might  
382 help raise quality of life in their current stage and reduce symptoms of depression, might  
383 help to prolong their state of independence. Research suggests that the multidimensional  
384 programs that include cardiovascular, resistance, balance, including cardiovascular and  
385 motor fitness training might achieve good results not only in improving quality of life but also  
386 cognitive improvements (31).

387

388 One of the limitations of this study is that it was carried out in community elderly day centers  
389 in a single district of Santiago, where 80% of the attendees were women and heterogeneity  
390 might have been sub-optimal. However, one of its strengths is that the measurements were  
391 performed in a standardized way. High standards in procedures provide confidence in the  
392 measurements. Measurements were carried out by students from health science programs  
393 and professionals, who were previously trained, and the instruments used for the  
394 measurements are validated in Chile. Also, data capture was done in a standardized way  
395 using REDCap platform.

396

397 Understanding the potential causes of significant differences in older adults' dependency  
398 could help prioritize the focus of multidimensional programs on health and prevention with  
399 the aim of prolonging older adults state of independence and improving quality of life for  
400 older adults with slight levels of dependency. In this study, 53% of older adults enjoy of total  
401 independence, a fact that is in line with the integral geriatric evaluation done in 60 older  
402 adults in Colombia, in which 47% of them were independents (32). Future research should

403 try to answer whether multidimensional programs are effective in reducing dependency and  
404 increasing quality of life.

405  
406 **Declarations:**

407  
408 **Ethics approval and consent to participate**

409  
410 **Ethics Approval**

411  
412 All procedures performed in studies involving human participants were in accordance with  
413 the ethical standards of the institutional and/or national research committee and with the  
414 1964 Helsinki Declaration and its later amendments or comparable ethical standards and  
415 approved by the relevant institutional review boards.

416  
417 Patient sera were collected in accordance with the code of conduct of research with human  
418 material in Chile. This study was approved by the ethical committee of Universidad de los  
419 Andes, also called 'Comité de Etica de Universidad de Los Andes'. The ethics committee,  
420 reviewed and approved this project and the informed consent to participate form with the  
421 code CEC201866, from October-2018, according to current Chilean regulations.

422  
423 **Consent to participate**

424  
425 Informed consent was obtained from each study participant after they were told of the  
426 potential risks and benefits as well as the investigational nature of the study.

427  
428 **Conflict of Interest**

429  
430 The authors declare that they have no conflicts of interest.

431  
432 **Consent for publication**

433  
434 Not applicable

435  
436 **Availability of data and materials**

437  
438 The data that support the findings of this study are available on request from the  
439 corresponding author, MTV. The data are not publicly available due to their containing  
440 information that could compromise the privacy of research participants.

441  
442 **Competing interests**

443  
444 None

445  
446 **Funding**

447  
448 Universidad de los Andes (Chile)

449  
450 **Authors' contributions**

451

452 YF, MTV, and PSM wrote the main manuscript with all its figures and tables.

453

454 MTV, CR, DG, AG, RGV, IP, MPU, and PSM conducted the intervention and collected the  
455 data.

456

457

#### 458 **Acknowledgements**

459

460 We are thankful to all the students in the Medicine Faculty at the University of los Andes and  
461 Puente Alto CEDIAM staff that helped us with the measurements and survey application  
462 during the study. We are also thankful for the invaluable advice that Dr. David Torres  
463 provided us with his comments.

464

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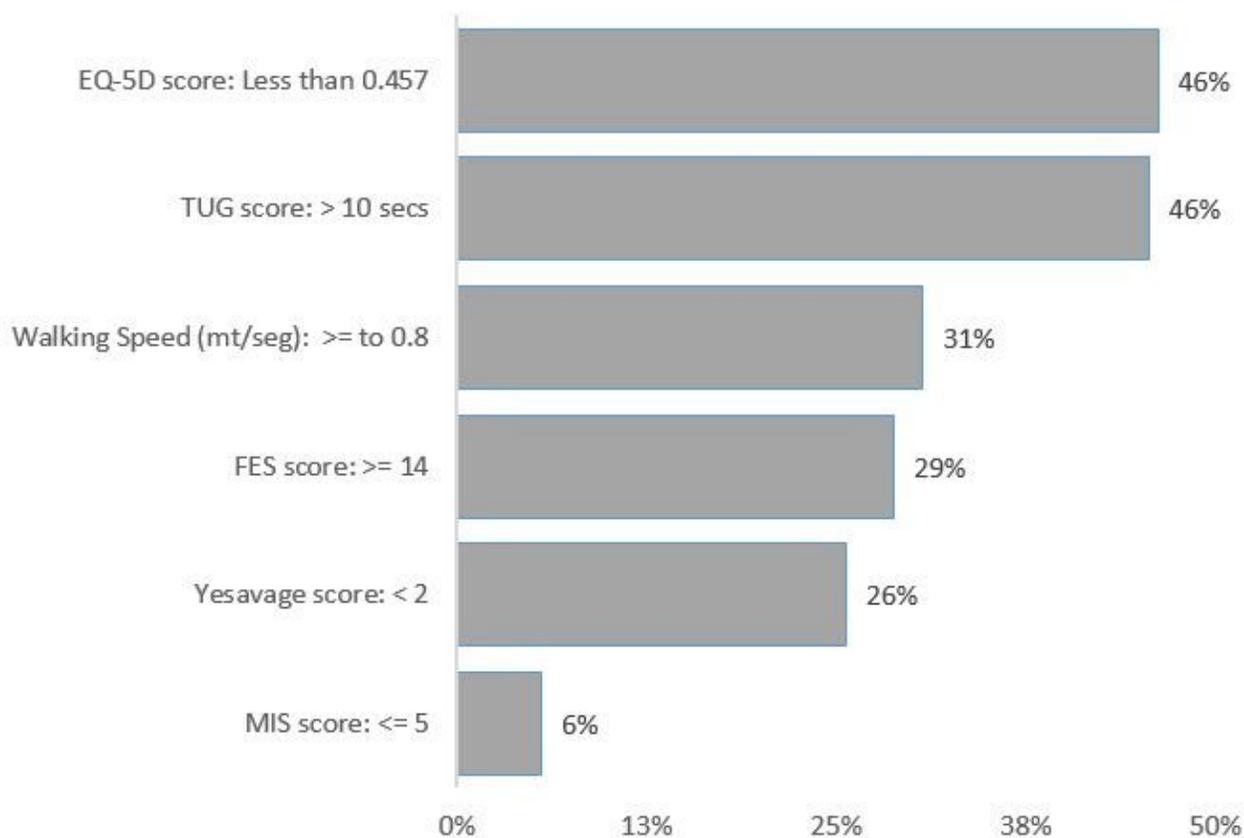
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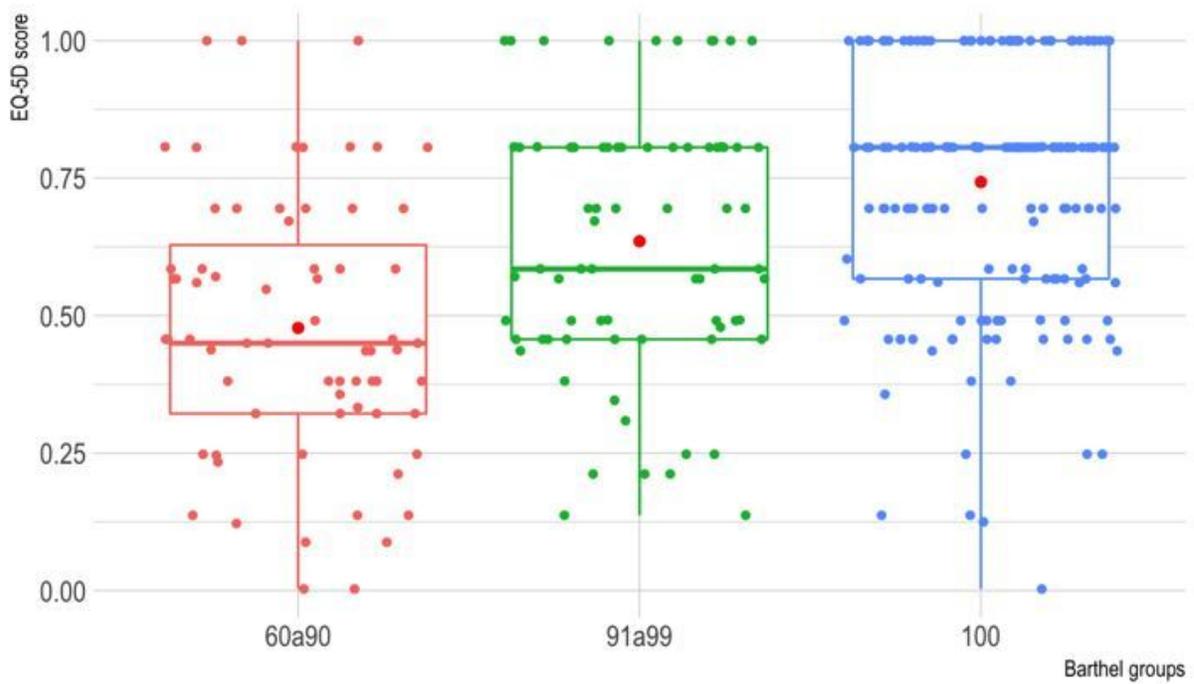
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# Figures



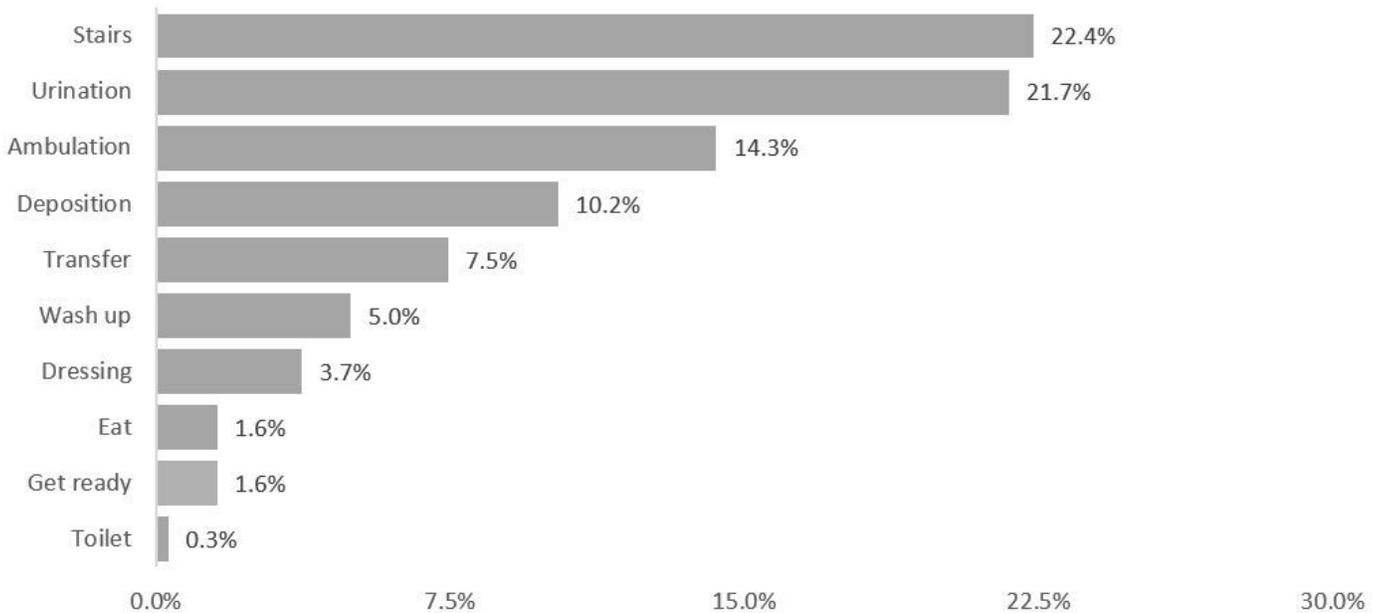
**Figure 1**

Difference between percentages of Barthel moderate dependence (60-90) and independence (100) for each score. Note: The percentage for each score is calculated taking the difference between the percentage of older adults classified as independent and moderate dependency. For example, for EQ-5D score, 60% of all older adults were either slight or moderate dependent (less than 0.457 points in the EQ-5D test) and 14% of all older adults were independence (higher than 0.457 points in the EQ-5D test). The difference of 46% is reflected in this Figure.



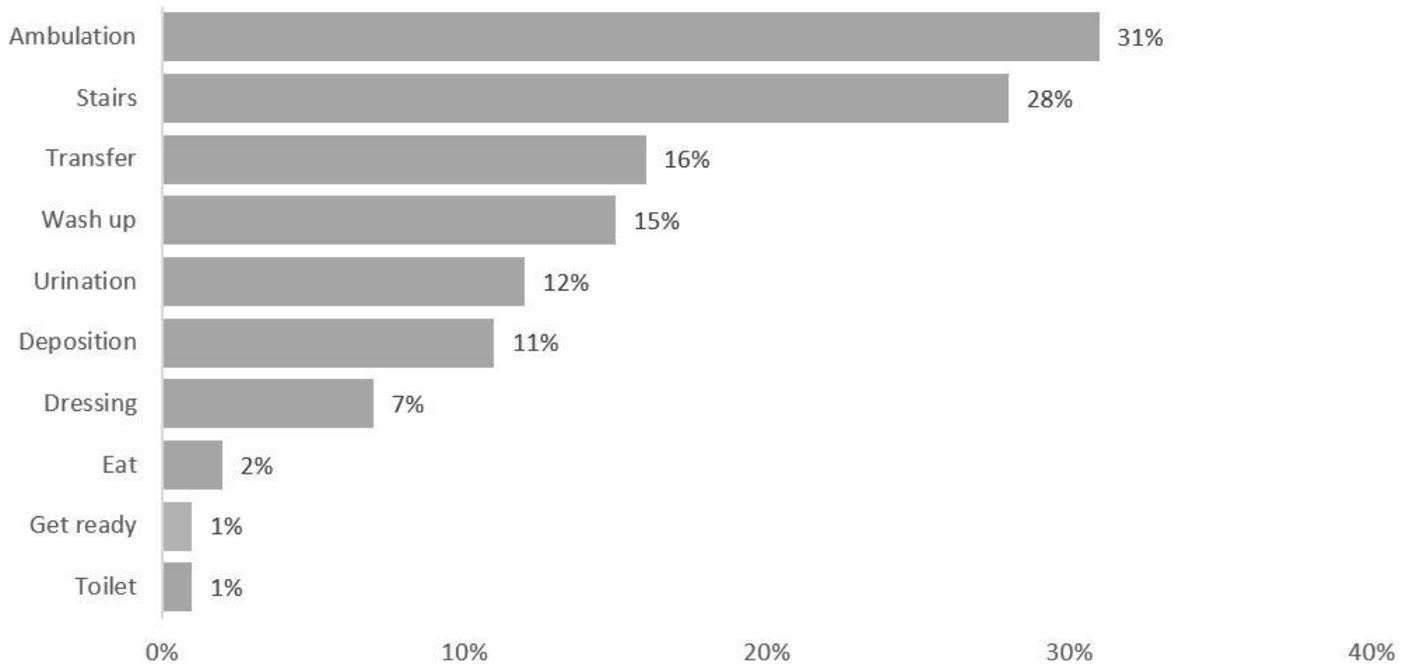
**Figure 2**

Boxplot of EQ-5D score for the 322 older adults clustered by group of dependency. Note: The red dot in each box represents the mean value for that group.



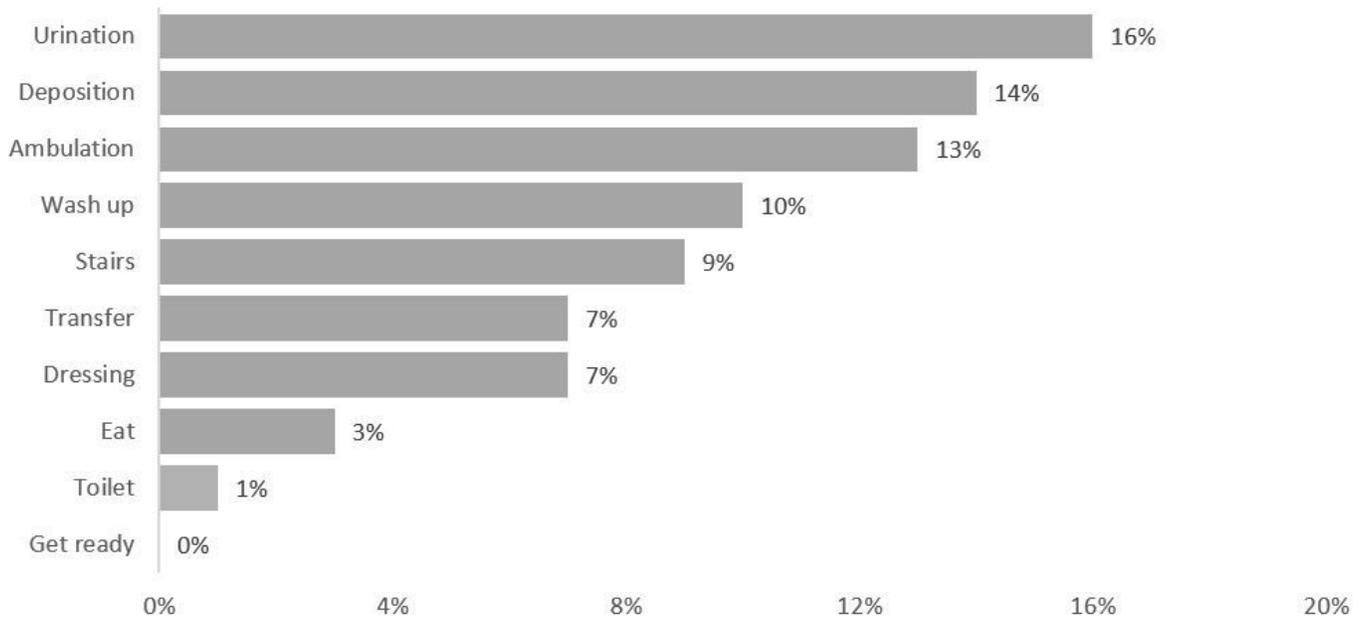
**Figure 3**

Percentage of older adults with Barthel Index less than maximum score per activity. Note: (a) Each percentage per activity was calculated by as the number of older adults with a score lower than the maximum score for that activity divided by the 322 older adults. For example, for climbing stairs, 72 out of the 322 older adults scored less than 10 points (max score). (b) \*\*\* test of proportions p-value < 0.05.



**Figure 4**

Difference between percentage of older adults over and under 0.457 EQ-5D scores by Barthel activity. Notes: (a) The percentage for each activity is calculated taking the difference between the percentage of older adults classified above or below the EQ-5D cutoff score of 0.457 for all older adults classified with maximum score for that activity. For example, for ambulation, 93% of all older adults with a higher score than 0.457 points in the EQ-5D test scored also the maximum score for ambulation in the Barthel Index, but only 63% of all older adults with a lower score than 0.457 points in the EQ-5D test scored also the maximum for ambulation in the Barthel Index. The difference of 31% is reflected in this Figure. (b) \*\*\* test of proportions p-value < 0.05.



**Figure 5**

Difference between percentage of older adults over and under 2 points for the Yesavage score by Barthel activity. Note: (a) The percentage for each activity is calculated taking the difference between the percentage of older adults classified above or below the Yesavage cutoff score of normality (score of 2) for all older adults classified with maximum score for that activity. For example, for incontinence of urination 82% of all older adults with a lower than 2 points in the Yesavage test scored the maximum for incontinence of urination in the Barthel Index, but only 66% of all older adults with a higher score than 2 points in the Yesavage test scored also the maximum for incontinence of urination in the Barthel Index. The difference of 16% between these two percentages is reflected in this Figure. (b) \*\*\* test of proportions p-value < 0.05.