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Sustained improvement of intrinsic capacity in community-dwelling older adults: The +AGIL Barcelona multidomain program

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Abstract. Ferrara MC, Pérez LM, Sole AR, Villa-García L, Ars J, Soto-Bagaria L, et al. Sustained improvement of intrinsic capacity in community-dwelling older adults: The +AGIL Barcelona multidomain program. *J Intern Med.* 2023;**OO**:1–15.

Background. Different programs promote healthy ageing through the optimization of intrinsic capacity. However, a major challenge is to assess their sustained effects over time. +AGIL Barcelona, a consolidated multidomain program, aims to optimize older adults' intrinsic capacity through a coordinated approach among primary care, geriatrics and community resources, in agreement with the integrated care for older people (ICOPE) guidelines. We aimed to evaluate the +AGIL Barcelona longitudinal effect on older adults' physical performance.

Methods. All +AGIL Barcelona consecutive participants since 2016 were enrolled. After a comprehensive geriatric assessment, a tailored, multidisciplinary intervention aligned with the ICOPE guidelines is offered. It includes a 10-week boost multicomponent exercise program, nutritional and sleep-hygiene counselling, revision and optimization of pharmacological treatments and screening for cognitive impairment, depression and loneliness. Changes in physical performance after 3 and 6 months were assessed using mixed models including baseline frailty degree, time and all potential significant confounders.

Results. We included 194 participants in the analysis (mean age = 81.6 [standard deviation = 5.8], 68% women). An independent, clinically and statistically significant improvement in physical performance (Short Physical Performance Battery [SPPB] test, combining gait speed, strength and balance) was found at 3 months (SPPB mean change: 1.4; 95% CI: 1.1–1.6) and 6 months (SPPB mean change: 1.1; 95% CI 0.8–1.5). Equivalent results were observed for all the SPPB sub-tests.

Conclusions. A coordinated, multidisciplinary and integrated program can benefit older adults' intrinsic capacity. The participants' empowerment and the connection with the available community resources are critical points for a successful intervention.

Keywords: frailty, healthy ageing, integrated care, multidimensional, physical performance

Introduction

Intrinsic capacity is defined as 'the composite of all the physical and mental capacities an individual can draw on' and is a core concept in the new framework of healthy ageing presented by the World Health Organization (WHO) in 2015 [1]. WHO strongly recommends optimizing the intrinsic capacity and functional ability of older individuals, taking into account the interaction between intrinsic capacity and the environment, in order to promote healthy aging. More recently, through the integrated care for older people (ICOPE) guidelines [2], the WHO provides recommendations for health and social care workers to develop and conduct person-centred ICOPE at the community level with the final aim of improving and maintaining intrinsic capacity and functional ability.

According to the WHO report on the topic 'Frailty and intrinsic capacity' [3], intrinsic capacity should be viewed as complementary to, but not reciprocal of frailty [4]. Frailty is a geriatric syndrome characterized by reduced physical reserve and increased vulnerability to stressors, leading to various adverse health outcomes [5, 6]. The two concepts share the same background and stem from the same rationale: individual's capabilities tend to diminish with age. Within the intrinsic capacity, models are nested and reorganized multiple aspects of various frailty theories and operationalization proposed over the last two decades [7]. The peculiarity of intrinsic capacity mainly stands in its innovative 'positive' connotation, which focuses on the residual biological capabilities of the organism rather than on deficits. It also strongly emphasizes the need for prevention from a social perspective with public health implications, whereas frailty is usually restricted to the healthcare sector [4]. Intrinsic capacity and frailty are embedded in a temporal continuum and are intended to inform the development of an integrated care model for older people [3]. This model of care should be based on the assessment of individual needs, preferences and goals, the development of a personalized care plan, and coordinated services delivered as much as possible through primary and community-based care [2]. Multidomain interventions, frequently including physical activity, nutritional counselling, cognitive stimulation, social interaction and caregiver support, have been described as effective in favouring healthy ageing [8–11]. Randomized controlled trials (RCTs) have shown a positive impact of multidomain interventions in preventing and managing frailty, especially when this is detected at its early stages [12]. Therefore, the prompt identification and management of conditions associated with intrinsic capacity decline may positively act on its trajectory.

Recently, different studies have been designed according to the WHO recommendations to foster intrinsic capacity improvement [10–15]. Although the effectiveness of disability prevention in older adults is solid in research settings [13–15], there is relatively scarce evidence showing the feasibility, sustainability and long-term effects when RCT evidence is translated to the real-world (real clinical practice and community settings), mainly due to logistic and economic constraints outside controlled experimental environments. The real challenge is to develop a feasible and sustainable multidomain intervention program, suitable for delivery in the community [16], whose effects can be maintained over time. This could be pursued by promoting integrated care, including community resources and empowering end-users.

+AGIL Barcelona is a real-world multidomain program for community-dwelling older adults, implemented in 2016 in primary care in Barcelona (Spain). In particular, it integrates primary and geriatric care teams with community resources [17]. It is a pragmatic and sustainable intervention, co-designed with professionals and end-users, which pursues the translation of evidence from RCTs to the community through an integrated care approach. +AGIL's strategy is to provide direct care for ten consecutive weeks in the primary-care setting, offering a tailored multimodal treatment aligned with the ICOPE WHO recommendations [2] and behavioural change techniques to encourage confidence in self-management. The program demonstrated a pre–post improvement in physical performance at 3 months [18]. Still, it remains to analyze if the benefits from the program can be maintained after the end of the first phase of direct interventions. Therefore, we aim to assess the +AGIL program's longitudinal impact over 6 months on community-dwelling older persons' physical performance.

Methods

Study population

The current study used data from consecutive participants enrolled in the +AGIL Barcelona

program from its implementation (i.e. July 2016) until March 2020. The study protocol was approved by the Clinical Research Ethics Committee of the Institut Universitari d'Investigació en Atención Primaria, Jordi Gol i Gurina. In line with the ICOPE guidelines [2], +AGIL provides a person-centred assessment through primary-care pathways, screening for loss in intrinsic capacity domains (i.e. cognitive decline, limited locomotor capacity, malnutrition, visual impairment, hearing loss and depressive symptoms) as well as health and social care needs. Consequently, a personalized and integrated care plan is delivered at the community level. Even though +AGIL implementation precedes the publication of the ICOPE guidelines, the intervention proposed is aligned with the ICOPE approach (Fig. 1).

+AGIL's main characteristics are: (a) it is based on the integration and coordination between primary care, geriatrics teams and community resources; (b) it offers an individualized, adaptable, flexible and person-centred plan based on the comprehensive geriatric assessment (CGA); (c) it was co-designed with all stakeholders, including professionals and end-users from the beginning, initially through a Co-Creating Innovative Solutions for Health Living Lab workshop at the University of Barcelona and then with subsequent workshops with stakeholders in the primary-care centre; (d) it promotes sustainability over time, through the participants' empowerment and implication of community resources and digital components and (e) it translates, contextualizes and implements the scientific evidence from RCTs into a real-life setting.

Potential participants are identified in the primary-care setting through the Gerontopôle Frailty Screening Tool (GFST) [19], a brief validated Yes/No questionnaire investigating frailty, which positive result allows the general practitioner to refer the older adult to the geriatric team (i.e. a geriatrician and physical therapist). Subjects who accept to participate undergo a CGA at baseline, at 3 months and at 6 months (the 6-month time-point evaluation was not initially part of the program but was added in July 2017 to assess the longitudinal sustainability of the program). Participants who completed at least the 3-month follow-up visit were considered for this longitudinal analysis.

A total of 342 people were screened; 270 (78.9%) were invited and accepted to participate in the program. Reasons reported for non-participation were logistical problems in attending multicomponent exercise program (MEP) sessions, limitations due to medical conditions or physical disabilities, and refusal to participate without apparent reason. Among the participants, 194 (71.9%) completed at least the 3-month follow-up visit and were thus included in the present analysis. As for the subjects not included in the analyses, 30 did not attend the 3-month assessment due to COVID-19 lockdown restrictions, 12 refused the follow-up visit even after having completed ≥75% of MEP sessions, 10 did not complete the MEP program and 24 experienced major health-related events (including one death). A total of 109 participants completed the 6-month follow-up assessment. Fifty-three subjects did not attend the 6-month follow-up visit due to COVID-19 lockdown restrictions or personal logistical reasons, whereas 32 were due to medical events (including one death). A detailed participants' flow chart description is shown in (Fig. 2).

Intervention

Participants were offered a tailored multidomain and multidisciplinary intervention based on the results of the CGA. The plan, extensively reported elsewhere [17], includes:

(a) A 10-week boost of MEP guided by a physiotherapist, performed 1 h/week. The exercise program incorporates resistance, endurance, balance and flexibility training and is modulated according to the participants' capacity. The weekly sessions are complemented with paper and/or digital materials (a simple list of exercises with instructions made up of pictures, easily interpretable by illiterate and/or cognitively impaired participants), aimed to empower participants in the regular conduction of physical exercise and increase physical activity levels, for example through the validated Vivifrail platform (designed to prevent frailty and falls in older adults through a personalized MEP) [20].

(b) Other non-pharmacological interventions directed to promote healthy lifestyle habits (e.g. improving adherence to the Mediterranean diet and sleep hygiene). Education and guidance towards adopting healthier habits are strongly emphasized at the beginning, during the MEP, and at the

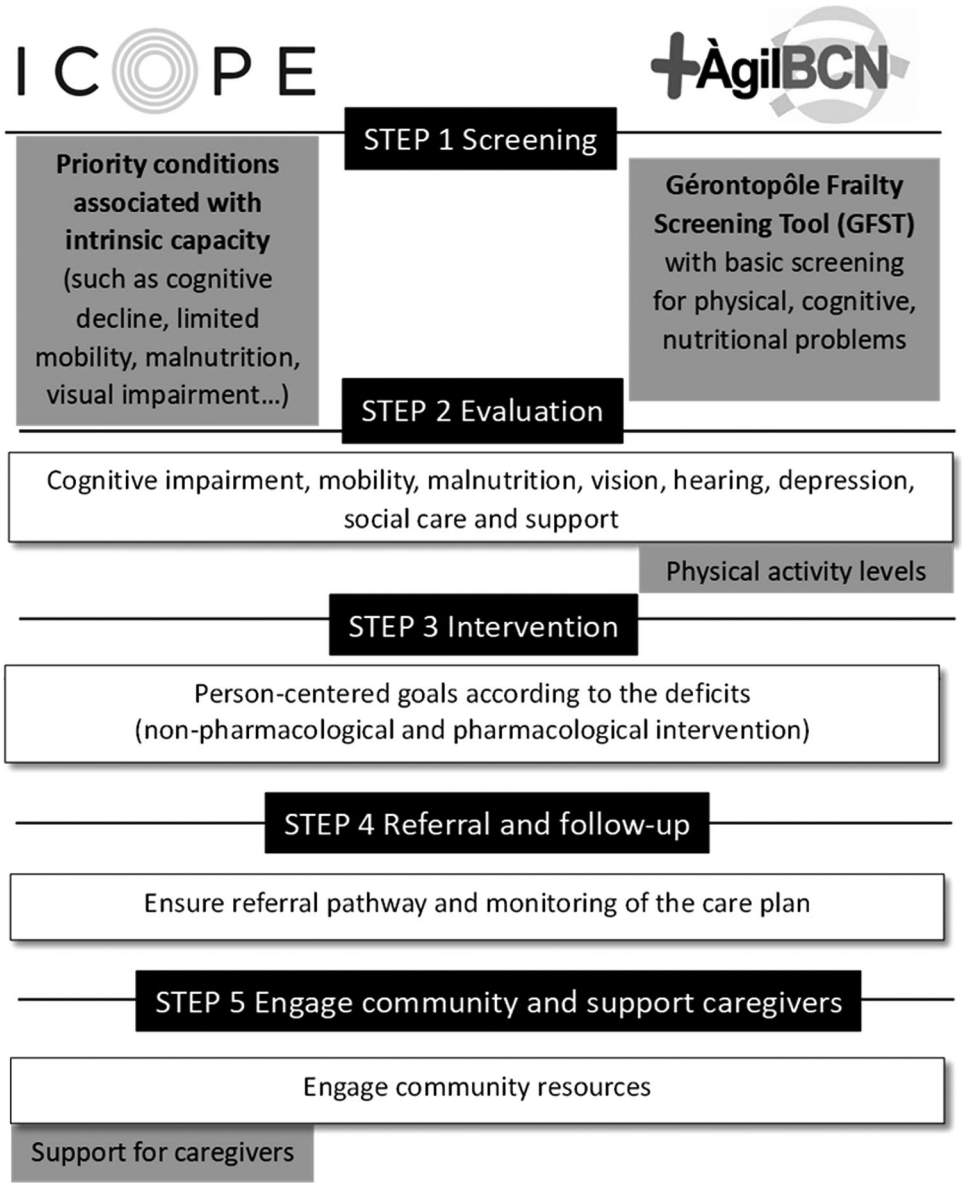

Fig. 1 *Scheme of the +AGIL Barcelona and its fit within the World Health Organization (WHO) integrated care for older people (ICOPE) framework. Common elements of the ICOPE and +AGIL Barcelona are in the white bars, whereas specific differential elements are in the grey boxes, respectively, in the left and right columns of the scheme.*

follow-up, using a motivational interviewing approach. This counselling method helps people explore and resolve ambivalence about behavioural change. It supports self-efficacy since subjects' confidence in their ability to change is critical to successful efforts in a collaborative therapeutic relationship [21]. Moreover, in case of a positive screening for cognitive impairment, depression and loneliness, the person is referred to specific resources in the healthcare system or the community.

(c) Comprehensive medication review, consisting of pharmacological optimization and deprescribing (with the eventual remote support of

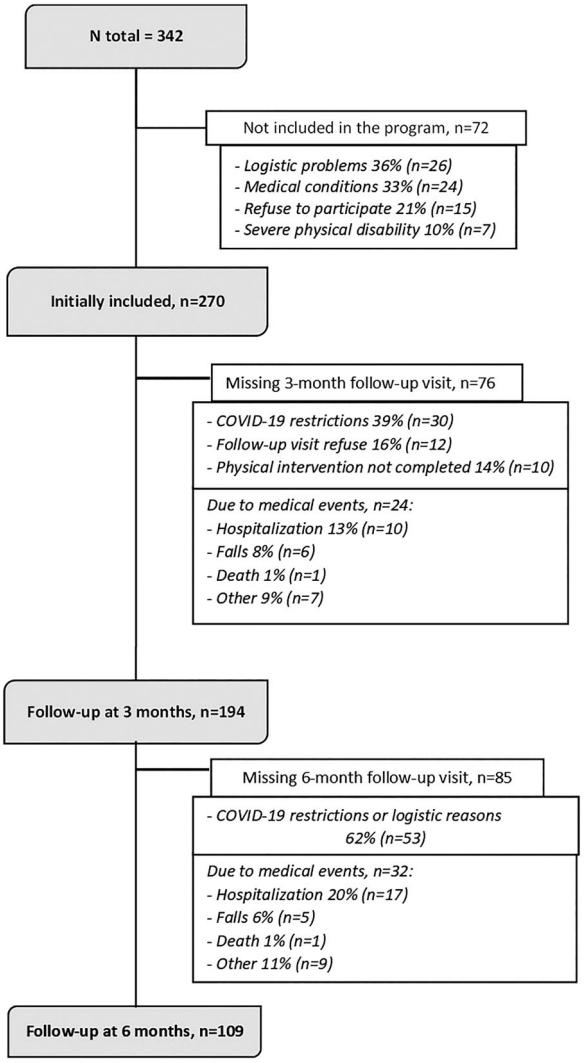

Fig. 2 *Flow chart of participants included versus not included from the current study at any step of the +AGIL program (baseline, 3 and 6 months).*

a clinical pharmacist), in agreement with the participant and their general practitioner.

Covariates

We collected sociodemographic data, clinical characteristics (including Charlson's Comorbidity index) [22] and current pharmacological treatments. The basic activities for daily living (ADLs) and instrumental activities of daily living (IADLs) were measured with the Barthel index (range from 0 [completely dependent] to 100 [completely independent]) [23] and the Lawton index (range from 0 [completely dependent] to 8 [completely independent]) [24]. Usual physical activity level was assessed using the Brief Physical Activity Assessment Tool (BPAAT, ranging from 0 to 8, a score $\geq$4 indicates sufficient physical activity) [25]. Frailty was measured using the Clinical Frailty Scale (CFS) [26], ranging from 1 (VeryFit) to 9 (Terminally Ill).

Outcomes

Physical performance was assessed using the Short Physical Performance Battery (SPPB) [27] at the three study visits. The SPPB is a three-component instrument that includes three timed tests: (a) the balance assessment in three different positions (i.e. side-by-side stand, semi-tandem stand and tandem stand); (b) the four-meter gait speed (GS); and (c) the Chair Stand Test. Each test is scored from 0 to 4 points, with a total score ranging from 0 (i.e. worst physical performance) to 12 points (i.e. best physical performance). Previous studies have consistently described that SPPB scores under 10 strongly predict disability and represent a proxy for frailty in non-disabled older adults [28]. It is widely used as a primary outcome in clinical trials focusing on the effect of exercise on physical function, and it has been included in the ICOPE guidelines to assess locomotor capacity [2].

Statistical analysis

Baseline characteristics of the sample are presented as mean values and standard deviation (SD) for continuous variables and frequency and percentages for categorical variables. As appropriate, we used the Student's *t*-test or the Mann–Whitney's *U*-test and chi-square test to compare the characteristics of included versus not included participants. The pre–post impact on physical function at 3 and 6 months was assessed using the paired sample *t*-test for repeated measures for the continuous variables and McNemar's test for categorical variables. According to the Chair Stand Test scoring attribution modality and previous studies [18], we attributed the value of 61 s (corresponding to 0 points in the Chair Stand Test score) for participants who tried but were unable to perform the Chair Stand Test ($n = 24$). The presence of balance impairment was considered positive when the participant could not achieve the four points in the balance sub-item from the SPPB test. We used mixed-effects linear

Table 1. *Descriptive analysis of the cohort, comparing participants included versus not included in the current analyses.*

	Total ($n = 342$)	Included ($n = 194$)	Not included ($n = 148$)	p-Value
Age, *mean (SD)*	82.2 (5.7)	81.6 (5.8)	83.2 (5.4)	0.04
Female, *n* (%)	240 (70.2)	132 (68)	108 (73)	0.323
Marital status, *n* (%)				0.163
Married	141 (41.2)	85 (43.8)	56 (37.8)	
Divorced	14 (4.1)	5 (2.6)	9 (6.1)	
Single	30 (8.8)	20 (10.3)	10 (6.8)	
Widow	157 (45.9)	84 (43.3)	73 (49.3)	
Lives alone, *n* (%)	140 (41.1)	76 (39.4)	64 (43.2)	0.464
Educational level, *n* (%)				0.340
Illiterate	25 (7.3)	10 (5.2)	15 (10.1)	
Primary school	139 (40.8)	78 (40.4)	61 (41.2)	
Secondary school	133 (39)	79 (40.9)	54 (36.5)	
University Degree	44 (12.9)	26 (13.5)	18 (12.2)	
Barthel index[a], *mean (SD)*	90.7 (12.1)	92.4 (8.7)	88.6 (15.3)	0.181
Lawton index, *mean (SD)*	5.2 (2.5)	5.4 (2.4)	4.9 (2.7)	0.065
Charlson index[b], *mean (SD)*	1.8 (1.6)	1.8 (1.6)	1.9 (1.7)	0.729
Number of drugs[c], *mean (SD)*	7.7 (3.3)	7.7 (3.4)	7.7 (3.2)	0.872
Falls in the last year, *n* (%)	164 (48)	92 (47.4)	72 (48.6)	0.822
SPPB[d], *mean (SD)*	7.3 (2.5)	7.4 (2.4)	7.1 (2.8)	0.305
Gait speed (m/s), *mean (SD)*	0.7 (0.2)	0.7 (0.2)	0.7 (0.2)	0.670
Chair Stand Test, *mean (SD)*	24.4 (16.5)	23.9 (15.7)	25.1 (17.5)	0.541
Balance impairment, *n* (%)	195 (57.9)	101 (52.1)	94 (65.7)	0.012
History of cognitive impairment or dementia, *n* (%)	69 (20.2)	36 (18.6)	33 (22.3)	0.393
Visual deficits, *n* (%)	285 (84.1)	163 (84.9)	122 (83.0)	0.635
Hearing deficits, *n* (%)	149 (43.8)	88 (45.6)	61 (41.5)	0.450
Malnutrition risk[e], *n* (%)				0.375
Normal nutrition status	213 (63.2)	118 (61.8)	95 (65.1)	
At risk of malnutrition	114 (33.8)	69 (36.1)	45 (30.8)	
Malnourished	10 (3)	4 (2.1)	6 (4.1)	
Clinical Frailty Scale *n* (%)				
Vulnerable	143 (41.9)	85 (44)	58 (39.2)	0.536
From mild to severe frailty	116 (34)	61 (31.6)	55 (37.2)	
Reported usual sufficient physical activity[f], *n* (%)	148 (43.5)	83 (43.2)	65 (43.9)	0.899

Abbreviations: SD, standard deviation; SPPB, Short Physical Performance Battery.
[a]Barthel index: range 0–100 points.
[b]Charlson index: range 0–8.
[c]Polypharmacy is defined as more than 5 drugs.
[d]SPPB: range 0–12 points (score <10 points is indicative of frailty).
[e]Mini Nutritional Assessment Short form score: range from 0 to 14 points (0–7: malnourished, 8–11: at risk of malnutrition and 12–14: normal).
[f]Brief Physical Activity Assessment Tool: range 0–8 (score ≥4 is indicative of sufficient physical activity.

regression models to evaluate changes in physical performance (i.e. SPPB total score, GS and Chair Stand Test) and mixed-effects logistic regression to evaluate changes in the balance between repeated measures along time (baseline, 3 and 6 months); p-values <0.05 were considered statistically significant. Besides including time and baseline frailty level (CFS strata: 1–3 = non-frail, 4 = vulnerable and 5–7 = from mild to severe frailty), we tested the effects of all other covariates that could potentially

confound the effect between frailty and the level of physical performance: age, gender, comorbidity (Charlson's index and individual comorbidities), living alone, marital status, educational level and the number of sessions performed within the physical exercise program. We kept in the models those factors showing an association with significance below $p = 0.2$. To test whether progression was different depending on the level of frailty at baseline, we included an interaction term between frailty strata and time in the mixed-effects models. To show the progression of SPPB and its components over time and for each stratum of the CFS, we depicted the estimated marginal mean effects by time and by frailty strata. Analyses were performed using SPSS 26.0 (IBM, United States) and Stata 17.

Results

Baseline characteristics were similar between participants included and not included in the present study (Table 1). No substantial differences were reported between the two groups.

The included participants (mean age = 81.6 [SD = 5.8] years, 68% women) had a relatively high rate of comorbidity and polypharmacy, they were mostly independent for ADL and IADL, and half of them were physically active. Conversely, almost 50% of subjects had experienced falls and had a relatively low physical performance, consistently with a high prevalence of frailty (75.6%).

Participants showed high adherence to the MEP (87.6% attended ≥75% of sessions, mean sessions attended 8.9 [SD 2.1]). Similar, high levels of adherence were reported for the health and nutritional recommendations. After 3 months, a statistically significant improvement in all physical performance measures was found. Furthermore, in those participants who attended the 6-month follow-up assessment, improvements in SPPB, GS and Chair Stand Test were confirmed, while only a proportion of subjects with balance impairment over the total amount of population improved at 6 months (Table S1). Looking at the mixed models for the impact of the +AGIL program over time, positive results achieved on SPPB, GS and Chair Stand Test remained stable at 6 months, as well as higher odds of having normal balance, regardless of potential confounders (Table 2).

(Fig. 3) shows the progression of the SPPB and its subitems GS and Chair Stand Test, overall and by levels of baseline frailty. We did not find a significant interaction between baseline frailty status and time for SPPB, Chair Stand Test and GS (p-value for the interaction term in the SPPB model = 0.077; 0.613 for the Chair Stand Test; 0.530 for the GS), whereas the interaction resulted significant for the balance model (p-value = 0.048). These results indicate that the 3-month improvement and the 6-month maintenance are achieved by older adults regardless of their baseline level of frailty, except for balance improvement, which is reached but not maintained in the frail subgroup (Fig. S1).

Discussion

In our sample, the +AGIL Barcelona multidomain intervention program positively impacted community-dwelling older adults' physical capacity. A significant clinical improvement in physical performance was observed after 3 months and maintained after 6 [29, 30]. Furthermore, our results were stable across baseline levels of frailty severity, except for the improvement in balance, which was sustained only in non-frail and vulnerable participants.

According to the ICOPE guidelines [2], providing an adequate engagement of community resources after follow-up visits is crucial to correctly managing older adults' healthcare. The empowerment intervention and the integration with the existing community's resources could play a relevant role in maintaining these results.

Our positive findings align with other relevant RCTs in the field. Successful multidomain interventions are based on a goal-setting approach, where older people are involved in defining the strategies to remain active and independent [31], and are fostered to be empowered with a holistic approach. The Lifestyle Interventions and Independence for Elders (LIFE) Study assessed the effect of long-term structured physical activity on mobility disability prevention in sedentary older persons with physical impairment [13]. The study reported that the 2-year physical activity program prevented major mobility disabilities compared to the health-education group. Similarly, the SPRINTT study (Sarcopenia and Physical fRailty IN older people: multicomponent Treatment strategies) has demonstrated that intensive and long-lasting multicomponent intervention is significantly associated with reducing the incidence of mobility disability among frail and

Table 2. *Results of the mixed models for the repeated measurements of physical function parameters (mixed-effects linear regression models for Short Performance Physical Battery [SPPB], Chair Stand Test and gait speed [GS]; mixed-effects logistic regression for balance test).*

		SPPB ***N* patients = 192** ***N* observations = 485**		**Gait speed** ***N* patients = 192** ***N* observations = 485**		**Chair Stand Test** ***N* patients = 179**[a] ***N* observations = 429**		**Balance test** ***N* patients = 193** ***N* observations = 489**	
		ß coefficient (95% CI)	***p*-Value**	**ß coefficient (95% CI)**	***p*-Value**	**ß coefficient (95% CI)**	***p*-Value**	**OR (95% CI)**	***p*-Value**
Time	**Baseline**	Ref		Ref		Ref		Ref	
	3 months	1.40 (1.13; 1.66)	<0.001	0.07 (0.05; 0.09)	<0.001	−4.00 (−4.95; −3.04)	<0.001	3.56 (1.94–6.52)	<0.001
	6 months	1.17 (0.84; 1.51)	<0.001	0.06 (0.03; 0.08)	<0.001	−4.80 (−6.01; −3.59)	<0.001	2.14 (1.06–4.35)	0.034
Frailty	***Non-frail***	Ref		Ref		Ref		Ref	
	Vulnerable	−0.91 (−1.62; −0.20)	0.012	−0.06 (−0.12; −0.004)	0.035	1.66 (−0.13; 3.44)	0.068	0.78 (0.26–2.29)	0.645
	Frail	−2.38 (−3.15; −1.60)	<0.001	−0.19 (−0.25; −0.12)	<0.001	3.01 (1.01; 5.00)	0.003	0.28 (0.09–0.92)	0.036
Age	***Per 1 year increase***	−0.05 (−0.10; −0.004)	0.033	−0.003 (−0.01; 0.001)	0.191	−0.02 (−0.15; 0.11)	0.768	0.87 (0.80–0.94)	0.001
Number of sessions	***Per one session increase***	0.13 (−0.02; 0.27)	0.082	0.007 (−0.004; 0.02)	0.222	−0.40 (−0.78; −0.02)	0.041	1.12 (0.91–1.38)	0.292

Note: ß coefficients indicate average change between each level and the reference level. ORs indicate the odds of having normal balance.
Abbreviations: CI, confidence interval; SPPB, Short Physical Performance Battery; OR, odds ratio.
[a]Patients unable to perform the Chair Stand Test were not included in this model.

sarcopenic older adults [14]. The study by de Souto Barreto et al. [11], a 3-year multidomain lifestyle intervention, showed to decrease the risk of developing frailty in older adults. Gené Huguet et al. also showed the benefits of a 6-month multidimensional training program among community-dwelling pre-frail older patients [10]. In this case, individuals in the intervention group, who presented a lower prevalence of frailty, improved their physical function (i.e. better performance in the Timed Up and Go test) compared to the control group after 12 months. Lastly, the REACT (Retirement in Action) study [15], addressed to community-dwelling older adults aged 65 years or older with mild-to-moderate mobility limitations, showed that a 12-month, group-based multimodal intervention, along with a behavioural maintenance program, can help prevent physical function decline over 24 months. It is worth noting that most studies have provided directed activities for the whole period of observation. Only some recent programs, such as Gené Huguet's and the REACT, interrupted or reduced the active intervention delivery, reassessing subjects' performances later [10, 15].

The presence of overt frailty did not affect physical performance improvement in our study, except for the balance subitem. This finding is in line with the current literature. The multicomponent intervention programs have shown effectiveness in subjects with different frailty degrees [8–15]. +AGIL shows an almost complete fit within the WHO ICOPE framework. Recommendations on multidomain interventions support our approach, considering frail and non-frail older adults as effective beneficiaries of intervention programs [2]. ICOPE recommends that multidomain interventions should be personalized to the individual's deficits, covering all the intrinsic capacity domains, favouring recovery or maintaining the functional ability of subjects. The intensity of the interventions should be adapted to the participants and their priorities and needs. In our case, tailoring the intervention based on the initial CGA results guaranteed this individualization.

+AGIL's real-world population is, on average, older and with more cognitive impairment compared to the other RCTs' populations [9, 13–15]. The +AGIL intervention program addresses all the intrinsic capacity domains according to the ICOPE recommendations. Comparing it to the LIFE and the REACT studies, it consists of a briefer and less intensive physical intervention (1 h/week for 10 weeks) [13, 15], but the +AGIL baseline physical activity level assessment, which is not included in the ICOPE baseline evaluation, may allow a better tailored physical exercise program. +AGIL program also personalized the methodology of physical treatment provision, combining in-person exercises and home exercises, using paper or digital materials (Vivifrail App) [20] and complements physical exercise with health education aimed at reducing sedentary behaviour. Moreover, the involvement of the existing community services allows this program to be easily accessible and integrated into older adults' everyday life. It does not require expensive evaluations or treatments; its feasibility and sustainability rely on the reorganisation of the existing primary care and geriatrics resources, applying motivational interviewing approach to promote behavioural everyday-life changes, and a weekly physiotherapist-guided group session of multicomponent physical exercises. Consequently, +AGIL Barcelona is part of the current usual care services in this area of Barcelona, being a good starting point example for current scaling up into similar community contexts.

Our results suggest that older adults' intrinsic capacity of older people at various baseline frailty degree may benefit from such a multidomain program. Intrinsic capacity might be considered a sort of evolution of the frailty concept, focusing on functions rather than deficits, working on trajectories and anticipating as much as possible the individual self-empowerment for their health status, thus supports preventive strategies in the community [4]. Both frailty and intrinsic capacity assume that a comprehensive evaluation is needed to assess the individual adequately and to offer a novel healthcare model based on integrated and multidisciplinary services. The focus is to promote healthy tailored strategies to reverse, slow or arrest the losses. Although both frailty and intrinsic capacity are dynamic entities, frailty is mainly used for assessing older adults in clinical settings, whereas intrinsic capacity includes a longitudinal perspective of the person in the community. This last approach has the benefit of tracing trajectories when acting to reverse trends and inform about the effectiveness of implemented interventions or the variation in needs [4].

The first limitation of our study is that it does not include a control group or randomization.

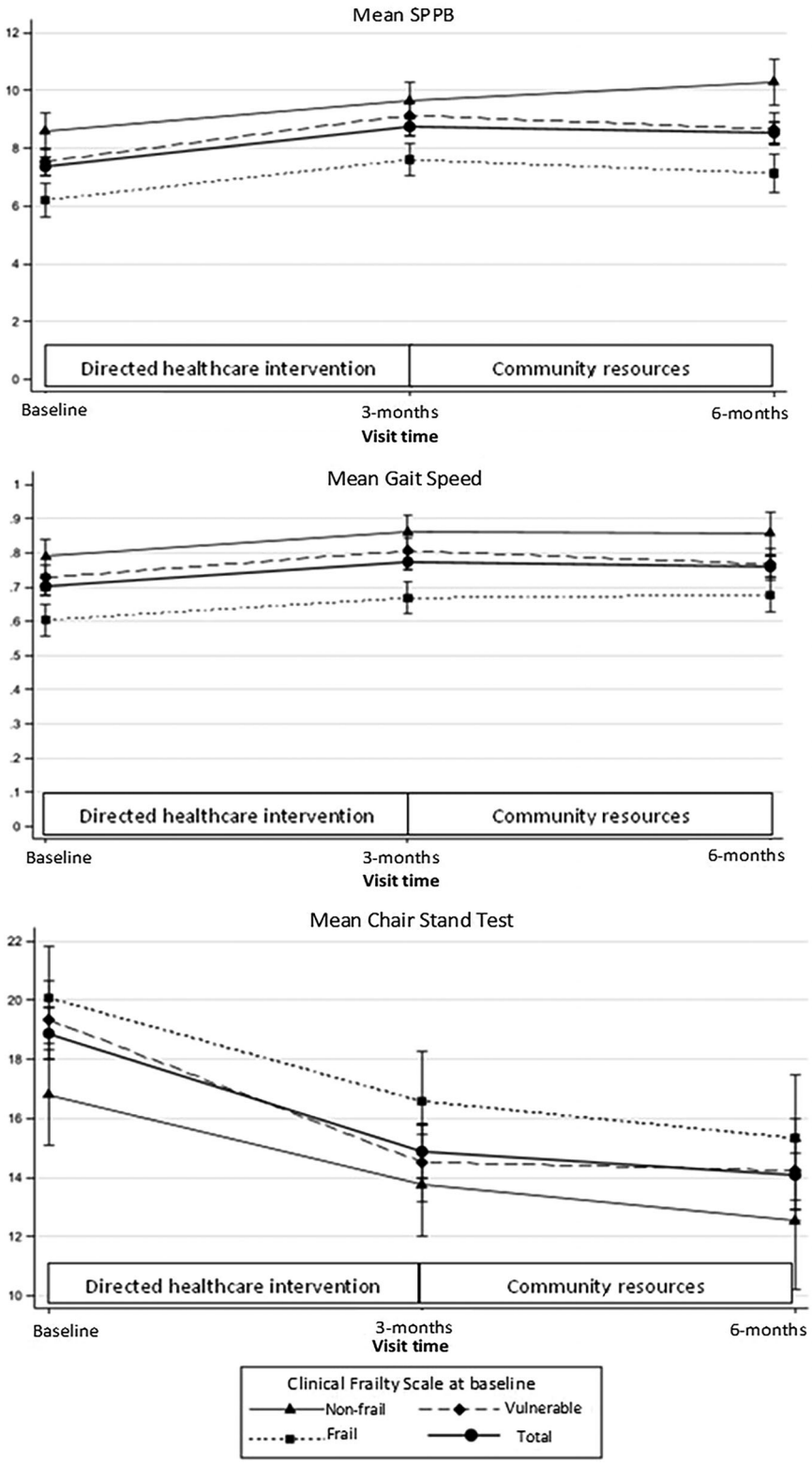

Fig. 3 *Physical performance variables over 6-month follow-up, according to Clinical Frailty Scale at baseline (linear mixed models' predictions, adjusted for potential significant confounders).*

However, this is in line with the original mission of the +AGIL team, which was primarily to promote a sustainable implementation of the program in the daily context rather than conduct a research study. Second, the number of participants completing the 6-month follow-up visit was lower than those assessed at the baseline. COVID-19 pandemic restrictions played a major role in this observation, preventing several subjects from attending the follow-up visit [32]. Also, at the beginning of the program, the 6-month follow-up was not contemplated, and it was subsequently incorporated to test the program's long-term impact. Some people also abandoned the program for different reasons, primarily related to their health or functional status, consistently with the frail profile of the +AGIL participants. However, the main part of baseline characteristics was comparable between included and excluded subjects.

Despite these limitations, our research has several strengths. The analyzed data comes from a real-world clinical setting population, with one out of five older subjects affected by cognitive impairment or dementia and different degrees of frailty. The longitudinal design with different follow-up visits, and the relatively low missing data for the reassessed participants are other strengths. From an implementation point of view, the program has been planned through a co-designed process, favouring adherence and commitment to primary care and community resources. +AGIL is a highly affordable and sustainable community program (as it is still ongoing almost 7 years after its implementation). It does not require expensive resources but is based on the reorganization of existing ones. Indeed, it offers the opportunity to reorient and integrate existing care services in response to older adults' needs according to the ICOPE recommendations.

+AGIL is a modern multimodal intervention program that provided relevant results regarding physical improvement among community-dwelling older adults, favouring regain of their intrinsic capacity. Although it was developed immediately before ICOPE guidelines publication [2], it has been shown to keep up with the times. Favouring intrinsic capacity improvement is crucial to enable long-term older adults' well-being. Our integrated multidisciplinary program addresses priority conditions associated with declines in intrinsic capacity, resulting in benefits over time. In the recently published qualitative study on participants' perception [33], the +AGIL program was shown to have a positive impact on participants, with direct perceived benefits for their health and physical condition, and emotional well-being, due to the development of interpersonal relationships, social contacts and enhanced self-confidence. We speculate that the involvement with community services and the empowerment intervention represent key aspects of the success of this program, strongly emphasizing the importance of subjects' ideas, knowledge and personal experiences to make changes and improve their health status. The +AGIL multidomain program has started a scaling-up process in other urban areas from Barcelona. Despite the need for a future controlled design in our specific setting, the findings of our implementation-research experience should encourage to start analogous collaborations in countries where this is not the usual practice. Still, the transferability of this model to other national health services should be demonstrated.

Author contributions

Maria Cristina Ferrara had access to the data and was involved in the conception and design of the work, data analysis and interpretation, the writing of the article and final approval of the version before submission. Laura Mónica Pérez and Aida Ribera Sole had access to the data and were involved in the conception and design of the work, data analysis and interpretation, critical revision of the article and final approval before submission. Lorena Villa-García was involved in the design of the work and final approval before submission. Joan Ars and Luis Soto-Bagaria were involved in the design of the work, data collection and final approval before submission. Giuseppe Bellelli, Matteo Cesari and María Belén Enfedaque were involved in the design of the work, critical revision of the article and final approval before submission. Marco Inzitari was involved in the conception and design of the work, critical revision of the article and final approval before submission. All authors reviewed the final manuscript and agreed to be accountable for all aspects of the work.

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Conflict of interest statement

L.M. Pérez has received honoraria for teaching activities by Nestlé, unrelated to the topic of the present work. M. Inzitari has also received honoraria from Nestlé for presenting at scientific meetings and serving as member of expert advisory boards, unrelated to the present work. All other authors declare no interest.

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Data availability statement

Individual participant data cannot be made publicly available due to the sensitive nature of the personal health data collected from a vulnerable population and privacy and confidentiality reasons. However, under certain conditions, these data could be accessible for statistical and scientific research. For further information, please contact the corresponding author.

References

1 World Health Organization (WHO). *World report on ageing and health*. Geneva: World Health Organization (WHO); 2015. https://apps.who.int/iris/handle/10665/186463 (accessed April 2, 2019).
2 World Health Organization (WHO). *Integrated care for older people: guidelines on community-level interventions to manage declines in intrinsic capacity*. Geneva: WHO; 2017. http://apps.who.int/iris/handle/10665/258981 (accessed April 2, 2019).
3 WHO Clinical Consortium on Healthy Ageing. Report of consortium meeting 1–2 December 2016 in Geneva, Switzerland (WHO/FWC/ALC/17.2). Geneva: World Health Organization; 2017.
4 Belloni G, Cesari M. Frailty and intrinsic capacity: two distinct but related constructs. *Front Med (Lausanne)*. 2019;**6**:133. https://doi.org/10.3389/fmed.2019.00133.
5 Thillainadesan J, Scott IA, Le Couteur DG. Frailty, a multisystem ageing syndrome. *Age Ageing*. 2020;**49**(5):758–63. https://doi.org/10.1093/ageing/afaa112.
6 Dent E, Martin FC, Bergman H, Woo J, Romero-Ortuno R, Walston JD. Management of frailty: opportunities, challenges, and future directions. *Lancet*. 2019;**394**(10206):1376–86. https://doi.org/10.1016/S0140-6736(19)31785-4.
7 Cesari M, Araujo De Carvalho I, Amuthavalli Thiyagarajan J, Cooper C, Martin FC, Reginster J-Y, et al. Evidence for the domains supporting the construct of intrinsic capacity. *J Gerontol A: Biol Sci Med Sci*. 2018;**73**(12):1653–60. https://doi.org/10.1093/gerona/gly011
8 Dedeyne L, Deschodt M, Verschueren S, Tournoy J, Gielen E. Effects of multi-domain interventions in (pre)frail elderly on frailty, functional, and cognitive status: a systematic review. *Clin Interv Aging*. 2017;**12**:873–96. https://doi.org/10.2147/CIA.S130794.
9 Ngandu T, Lehtisalo J, Solomon A, Levälahti E, Ahtiluoto S, Antikainen R, et al. A 2 year multidomain intervention of diet, exercise, cognitive training, and vascular risk monitoring versus control to prevent cognitive decline in at-risk elderly people (FINGER): a randomised controlled trial. *Lancet*. 2015;**385**(9984):2255–63. https://doi.org/10.1016/S0140-6736(15)60461-5.
10 Gené Huguet L, Navarro González M, Kostov B, Ortega Carmona M, Colungo Francia C, Carpallo Nieto M, et al. Pre Frail 80: multifactorial intervention to prevent progression of pre-frailty to frailty in the elderly. *J Nutr Health Aging*. 2018;**22**(10):1266–74. https://doi.org/10.1007/s12603-018-1089-2.
11 de Souto Barreto P, Rolland Y, Maltais M, Vellas B; MAPT Study Group. Associations of multidomain lifestyle intervention with frailty: secondary analysis of a randomized controlled trial. *Am J Med*. 2018;**131**(11):1382.e7–13. https://doi.org/10.1016/j.amjmed.2018.06.002.
12 Kivipelto M, Mangialasche F, Ngandu T. Lifestyle interventions to prevent cognitive impairment, dementia and Alzheimer disease. *Nat Rev Neurol*. 2018;**14**(11):653–66. https://doi.org/10.1038/s41582-018-0070-3.
13 Pahor M, Guralnik JM, Ambrosius WT, Blair S, Bonds DE, Church TS, et al. LIFE study investigators. LIFE study investigators. Effect of structured physical activity on prevention of major mobility disability in older adults: the LIFE study randomised clinical trial. *JAMA*. 2014;**311**(23):2387–96. https://doi.org/10.1001/jama.2014.5616.
14 Bernabei R, Landi F, Calvani R, Cesari M, Del Signore S, Anker SD, et al. SPRINTT consortium. Multicomponent intervention to prevent mobility disability in frail older adults: randomised controlled trial (SPRINTT project). *BMJ*. 2022;**377**:e068788. https://doi.org/10.1136/bmj-2021-068788.
15 Stathi A, Greaves CJ, Thompson JL, Withall J, Ladlow P, Taylor G, et al. Effect of a physical activity and behaviour maintenance programme on functional mobility decline in older adults: the REACT (Retirement in Action) randomised controlled trial. *Lancet Public Health*. 2022;**7**(4):e316–26. https://doi.org/10.1016/S2468-2667(22)00004-4.
16 Stathi A, Western M, De Koning J, Perkin O, Withall J. Implementing physical activity programmes for community-dwelling older people with early signs of physical frailty. In: Nyman S, editor. *The Palgrave handbook of ageing and physical activity promotion*. Cham: Palgrave Macmillan, 2018. p. 401–22.
17 Inzitari M, Pérez LM, Enfedaque MB, Soto L, Díaz F, Gual N, et al. Integrated primary and geriatric care for frail older adults in the community: implementation of a complex intervention into real life. *Eur J Intern Med*. 2018;**56**:57–63. https://doi.org/10.1016/j.ejim.2018.07.022.
18 Pérez Bazán LM, Enfedaque-Montes MB, Cesari M, Soto-Bagaria L, Gual N, Burbano MP, et al. A community program of integrated care for frail older adults: +AGIL Barcelona.

J Nutr Health Aging. 2019;**23**(8):710–16. https://doi.org/10.1007/s12603-019-1244-4.
19 Vellas B, Balardy L, Gillette-Guyonnet S, Abellan Van Kan G, Ghisolfi-Marque A, Subra J, et al. Looking for frailty in community-dwelling older persons: the Gérontopôle Frailty Screening Tool (GFST). *J Nutr Health Aging.* 2013;**17**(7):629–31. https://doi.org/10.1007/s12603-013-0363-6.
20 Casas-Herrero Á, Sáez De Asteasu ML, Antón-Rodrigo I, Sánchez-Sánchez JL, Montero-Odasso M, Marín-Epelde I, et al. Effects of Vivifrail multicomponent intervention on functional capacity: a multicentre, randomised controlled trial. *J Cachexia Sarcopenia Muscle.* 2022;**13**(2):884–93. https://doi.org/10.1002/jcsm.12925.
21 Lundahl BW, Kunz C, Brownell C, Tollefson D, Burke BL. A meta-analysis of motivational interviewing: twenty-five years of empirical studies. *Res Soc Work Pract (RSWP).* 2010;**20**(2):137–60. https://doi.org/10.1177/1049731509347850.
22 Charlson ME, Pompei P, Ales KL, Mackenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis.* 1987;**40**(5):373–83. https://doi.org/10.1016/0021-9681(87)90171-8.
23 Mahoney FI, Barthel DW. Functional evaluation: the Barthel index. *Md State Med J.* 1965;**14**:61–5.
24 Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. *Gerontologist.* 1969;**9**(3):179–86.
25 Marshall AL, Smith BJ, Bauman AE, Kaur S. Reliability and validity of a brief physical activity assessment for use by family doctors. *Br J Sports Med.* 2005;**39**(5):294–97. https://doi.org/10.1136/bjsm.2004.013771.
26 Rockwood K A global clinical measure of fitness and frailty in elderly people. *CMAJ.* 2005;**173**(5):489–95. https://doi.org/10.1503/cmaj.050051.
27 Guralnik JM, Simonsick EM, Ferrucci L, Glynn RJ, Berkman LF, Blazer DG, et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. *J Gerontol.* 1994;**49**(2):M85–94. https://doi.org/10.1093/geronj/49.2.m85.
28 Guralnik JM, Ferrucci L, Pieper CF, Leveille SG, Markides KS, Ostir GV, et al. Lower extremity function and subsequent disability: consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. *J Gerontol A: Biol Sci Med Sci.* 2000;**55**(4):M221–M31. https://doi.org/10.1093/gerona/55.4.m221.
29 Perera S, Studenski S, Newman A, Simonsick E, Harris T, Schwartz A, et al. Are estimates of meaningful decline in mobility performance consistent among clinically important subgroups? (Health ABC study). *J Gerontol A: Biol Sci Med Sci.* 2014;**69**(10):1260–8. https://doi.org/10.1093/gerona/glu033.
30 Kwon S, Perera S, Pahor M, Katula JA, King AC, Groessl EJ, et al. What is a meaningful change in physical performance? Findings from a clinical trial in older adults (the LIFE-P study). *J Nutr Health Aging.* 2009;**13**(6):538–44. https://doi.org/10.1007/s12603-009-0104-z.
31 Bevilacqua R, Soraci L, Stara V, Riccardi GR, Corsonello A, Pelliccioni G, et al. A systematic review of multidomain and lifestyle interventions to support the intrinsic capacity of the older population. *Front Med (Lausanne).* 2022;**15**(9):929261. https://doi.org/10.3389/fmed.2022.929261.
32 Cesari M, Calvani R, Canevelli M, Aprahamian I, de Souto Barreto P, Azzolino D, et al. On Schrödinger's cat and evaluation of trials disrupted by the Covid 19 pandemic: a critical appraisal. *J Frailty Aging.* 2021;**10**(4):310–2. doi: 10.14283/jfa.2021.23.
33 Canet-Vélez O, Solis-Navarro L, Sitjà-Rabert M, Pérez LM, Roca J, Soto-Bagaria L, et al. Experience, facilitators, and barriers to the implementation of a multicomponent programme in older people living in the community, +AGIL Barcelona: a qualitative study. *Front Public Health.* 2023;**30**(11):1161883. https://doi.org/10.3389/fpubh.2023.1161883.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1 *Effect of the multidomain intervention on physical performance at 3 and 6 months (paired sample t-test for continuous variables and McNemar's test for dichotomous variables).***Fig. S1** *Marginal probability of having normal balance over 6-month follow-up, according to Clinical Frailty Scale at baseline (mixed-effects logistic regression).* ■