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Perspective

Measuring Active Ageing: Conceptual and Methodological Proposals for Public Health Research

Andrea Bosco [1,*], Alessandro Oronzo Caffò [1], Antonella Lopez [2], Rosa Napoletano [1], Elisabetta Ricciardi [3], Giuseppina Spano [4], Luigi Tinella [4], Sergio Traficante [1], Antonio Ascione [1], Michele Baldassarre [1], Vittoria Bosna [1], Carmine Clemente [1], Ylenia De Luca [1], Gabriella De Mita [1], Alberto Fornasari [1], Ignazio Grattagliano [1], Fabio Manca [1], Claudia Marin [1], Stefania Massaro [1], Loredana Perla [1], Francesco Fischetti [5], Gianpiero Greco [5], Matteo F. Patierno [5], Stefania Cataldi [6], Corrado Crocetta [7], Corrado Loglisci [8], Davide Lofrese [8], Giuseppe Palestra [8], Berardina De Carolis [8], Domenico Redavid [9], Eleonora Pane [10], Valeria Tatoli [11], Vanessa Desantis [3], Marialuisa Sveva Marozzi [3], Roberto Ria [3] and Angelo Vacca [3]

1 Department of Educational Sciences, Psychology, and Communication, University of Bari "Aldo Moro", 70122 Bari, Italy; alessandro.caffo@uniba.it (A.O.C.); rosa.napoletano@uniba.it (R.N.); sergio.traficante@uniba.it (S.T.); antonio.ascione@uniba.it (A.A.); michele.baldassarre@uniba.it (M.B.); vittoria.bosna@uniba.it (V.B.); carmine.clemente@uniba.it (C.C.); ylenia.deluca@uniba.it (Y.D.L.); gabriella.demita@uniba.it (G.D.M.); alberto.fornasari@uniba.it (A.F.); ignazio.grattagliano@uniba.it (I.G.); fabio.manca@uniba.it (F.M.); claudia.marin@uniba.it (C.M.); stefania.massaro@uniba.it (S.M.); loredana.perla@uniba.it (L.P.)
2 Department of Humanities, Social Sciences, and Education, University of Molise, 86100 Campobasso, Italy; antonella.lopez@unimol.it
3 Department of Precision and Regenerative Medicine and Ionian Area, University of Bari "Aldo Moro" Medical School, 70124 Bari, Italy; elisabetta.ricciardi@uniba.it (E.R.); vanessa.desantis@uniba.it (V.D.); marialuisa.marozzi@gmail.com (M.S.M.); roberto.ria@uniba.it (R.R.); angelo.vacca@uniba.it (A.V.)
4 Department of Psychology and Health Science, Pegaso University, 80143 Naples, Italy; giuseppina.spano@unipegaso.it (G.S.); luigi.tinella@unipegaso.it (L.T.)
5 Department of Translational Biomedicine and Neuroscience, University of Bari "Aldo Moro" Medical School, 70124 Bari, Italy; francesco.fischetti@uniba.it (F.F.); gianpiero.greco@uniba.it (G.G.); matteo.fpm@icloud.com (M.F.P.)
6 Department of Education and Sport Sciences, Pegaso University, 80143 Naples, Italy; stefania.cataldi@unipegaso.it
7 Department of Humanities Research and Innovation, University of Bari "Aldo Moro", 70124 Bari, Italy; corrado.crocetta@uniba.it
8 Department of Computer Science, University of Bari "Aldo Moro", 70125 Bari, Italy; corrado.loglisci@uniba.it (C.L.); d.lofrese1@gmail.com (D.L.); giuseppepalestra@gmail.com (G.P.); berardina.decarolis@uniba.it (B.D.C.)
9 Department of Economics and Finance, University of Bari "Aldo Moro", 70124 Bari, Italy; domenico.redavid1@uniba.it
10 Social Services Department, Municipality of Acquaviva delle Fonti, 70021 Bari, Italy; eleonora.pane@comune.acquaviva.ba.it
11 Social Cooperative "Occupazione e Solidarietà", 70123 Bari, Italy; valeria_tatoli@virgilio.it
* Correspondence: andrea.bosco@uniba.it

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Highlights

Public health relevance—How does this work relate to a public health issue?

- Population ageing creates growing challenges for health and social services, highlighting the need to support older adults' independence, social participation, and equitable access to care.
- Active ageing depends not only on individual capacities and activities but also on social, economic, environmental, and digital opportunities that may differ across older populations.

Public health significance—Why is this work of significance to public health?

- Distinguishing participation from motivation, perceived ability, and available opportunities may help reveal unmet needs and inequalities that activity measures alone can overlook.

- Considering environmental and technological barriers can inform more inclusive approaches to healthy ageing and help identify obstacles to accessing community and remote support services.

Public health implications—What are the key implications or messages for practitioners, policy makers and/or researchers in public health?

- A context-sensitive approach could help health and social services tailor support and inform public health planning, including decisions about accessibility and the allocation of resources; its practical value requires validation.
- Future studies should examine whether this approach improves independence, social participation, and access to care, and assess its feasibility, costs, and implications for service use and public health financing.

Abstract

Ageing populations necessitate a shift towards proactive health management. The Italian AmICA project (Intelligent Holistic Support for Active Ageing in Indoor and Outdoor Ecosystems) integrates ubiquitous computing, the Internet of Medical Things (IoMT), and wearable devices for continuous remote monitoring. Assessing active ageing across heterogeneous populations presents conceptual and psychometric challenges. This perspective integrates findings from three previous publications: a scoping review of measurement tools across seven content areas, a methodological analysis of the University of Jyväskylä Active Ageing Scale (UJACAS) and its additive scoring model, and an empirical investigation of administration-order effects and associations with disability and environmental barriers, interpreted through the Capability, Opportunity, Motivation—Behaviour (COM-B) framework. Terminological and conceptual heterogeneity complicates comparisons across instruments. The UJACAS distinguishes activity from willingness, perceived ability, and opportunity, although combining these components into a total score raises interpretative concerns. In 76 older adults, no statistically significant differences were detected between the administration orders examined; this finding does not establish equivalence or general instrument stability. In a separate sample of 74 older adults, canonical correlation analysis suggested a prominent role for perceived opportunity in associations with functional limitations and environmental barriers. These findings remain preliminary and require confirmation in larger, more diverse samples. Building on this evidence, we propose an integrated assessment architecture for AmICA that connects behavioural, motivational, functional, contextual, and digital-access information to personalised intervention planning and outcome monitoring. Its practical usefulness and contribution to greater independence require prospective evaluation.

Keywords: Active ageing; Telemedicine; Ambient Assisted Living (AAL); UJACAS; COM-B model; Psychometrics; Person–environment interaction; AmICA project

1. Introduction

Demographic shifts toward an ageing global population present a critical challenge for national healthcare systems, necessitating a paradigm shift from reactive acute care to proactive, continuous, and personalized health management [1]. In the Italian context, recent years have witnessed an intensification of experimental telemedicine models and remote support services for older adults, aimed at reducing the demand for human resources to support both healthy and pathological ageing. Funded under the Italian Development and Cohesion Fund (FSC) within the Ministry of Health's "Piano Operativo Salute" (Tra-

jectory 1), the AmICA project (*Intelligent Holistic Support for Active Ageing in Indoor and Outdoor Ecosystems*) addresses these challenges by aligning with European and national strategic frameworks for Active and Healthy Ageing (AHA). The AmICA project seeks to enhance the quality of life, autonomy, and safety of older adults by combining specialized support with advanced technological integration. The primary objective of AmICA is to develop a technological, holistic care framework capable of delivering remote monitoring, tele-assistance, and personalized integrated interventions across both indoor (home/institutional) and outdoor environments. By mixing ubiquitous computing, Internet of Medical Things (IoMT) devices, and wearable sensors, the project aims to achieve the following:

1. Enable Continuous Remote Monitoring: Track psychological and physiological parameters, functional cognitive decline, and behavioural inconsistencies in real time.
2. Promote Seamless Ecosystem Continuity: Maintain unbroken monitoring and support transitions as elderly individuals move between private living spaces, healthcare facilities, and public outdoor environments.
3. Prevent De-Skilling and Isolation: Support cognitive and physical activation to preserve functional independence and foster social inclusion.
4. Optimize Healthcare Resource Delivery: Facilitate early intervention and post-discharge follow-up care, reducing unnecessary hospital readmissions and easing burdens on healthcare personnel.

The initial challenge of the project contained the need to evaluate and monitor the level and quality of physical and cognitive activities in the context of healthy ageing. To this end, the present paper aims to elucidate the advances made in this domain through the AmICA project, with a particular focus on the contributions of the psychometrics research unit.

1.1. Active Ageing

Population ageing has made it necessary to move beyond a view of old age centred on illness, functional loss, and care dependency. In this perspective, later life can also be seen as a phase characterised by opportunities for participation, learning, autonomy, and the maintenance of well-being, even in the presence of chronic conditions, functional limitations, or changes in social networks [2].

The concept of *active ageing* fits within this theoretical and political change. The World Health Organization (WHO) defined it as "*the process of optimising opportunities for health, participation and security in order to enhance quality of life as people age*" [3]. This definition does not identify active ageing with the simple absence of disease, or with the maintenance of high levels of productivity or physical activity. Rather, it presents it as a dynamic process in which individual and environmental opportunities contribute to sustaining quality of life across the ageing process [3,4].

Measuring active ageing therefore presents a significant methodological and conceptual challenge [5]. To measure active ageing means determining which dimensions of an older person's life should be regarded as central, at what level of observation they should be analysed, and how they must be integrated into a single indicator or a multidimensional profile. Consider, for instance, older adults' mobility via transportation: researchers must evaluate their fitness to drive alongside the potential increase in motor vehicle crash risk, e.g., [6]. When public transit is utilized, both individual functional capacity and public service quality must be assessed, e.g., [7], extending to the ability to navigate a residential facility once cognitive decline becomes overtly manifest, e.g., [8]. Consequently, methodological complexities escalate when assessments are applied to heterogeneous populations comprising healthy older adults, individuals with chronic conditions, patients in post-acute or post-discharge recovery phases, and individuals experiencing cognitive decline or institutionalized in care facilities.

Three complementary publications provide the basis for this Perspective. The scoping review by Napoletano and colleagues examined the heterogeneity of individual-level active ageing measures and the content coverage of the UJACAS [4]. The methodological perspective by Bosco and Lopez discussed conceptual and scoring issues, including the interpretation of ability and opportunity within the overall score [9]. The subsequent empirical study examined administration-order effects and associations with functional limitations and environmental barriers, interpreted through the COM-B framework [10,11]. Table 1 summarises their purposes, methods, findings or proposals, limitations, and contributions to the assessment architecture proposed here.

Table 1. Summary of the three previous publications and their contributions to the proposed AmICA assessment framework.

Publication	Purpose	Methods	Main Findings or Proposals	Limitations Relevant to This Perspective	Contribution to the Proposed AmICA Framework
Napoletano et al. [4]—Scoping review	Map individual-level active ageing measures and examine UJACAS content coverage.	Scoping review identifying 25 eligible documents; classification across seven content areas; evaluation of UJACAS content.	Substantial heterogeneity in terminology and content; broad UJACAS coverage, with several items spanning multiple areas.	Content coverage does not establish predictive validity, responsiveness, or suitability for every population and administration mode.	Supports multidimensional assessment and the use of complementary measures where further investigation is needed.
Bosco and Lopez [9]—Methodological Perspective	Examines conceptual, standardisation, and scoring issues in the UJACAS.	Theoretical and methodological analysis of the additive score and alternative interpretations of ability and opportunity.	Questions whether a total score adequately distinguishes activity from its enabling conditions; proposes contextual interpretation and possible score adjustment.	Proposed adjustments and weights require empirical testing; improved fairness or clinical usefulness has not been demonstrated.	Provides a rationale for examining component profiles and contextual constraints alongside overall scores.
Napoletano et al. [10]—Empirical research	Examine administration-order effects and associations with functional limitations and environmental barriers.	Administration-order comparison in 76 older adults; canonical correlation analysis in a separate sample of 74 older adults.	No statistically significant administration-order differences detected. The first retained canonical function primarily linked perceived opportunity with environmental barriers.	Small samples; absence of significant differences does not establish equivalence; associations do not demonstrate causation or moderation. Adapted administration and clinical benefits were not established.	Provides preliminary support for investigating environmental barriers alongside perceived opportunity and activity.

The original contribution of the present perspective is to translate these complementary findings and theoretical proposals into an integrated assessment architecture for AmICA. Specifically, we connect behavioural, motivational, functional, and contextual information, with attention to digital accessibility, to needs assessment, personalised intervention planning, and outcome monitoring. The previous publications provide a conceptual and preliminary empirical rationale for this approach; they do not validate the integrated framework itself. Its feasibility, validity in the intended populations, and effects on care decisions and clinical outcomes require prospective evaluation.

Building on these publications, the original contribution of this work is to translate their combined implications into a proposed assessment architecture for AmICA. Whereas the previous studies addressed instrument coverage, conceptual and scoring issues, and selected psychometric properties, this paper connects these findings to practical decisions about what to assess, how to interpret individual profiles, and how assessment can inform personalised support across different levels of functioning. Specifically, we propose integrating behavioural, motivational, functional, and contextual information, with explicit

attention to digital accessibility, in order to guide needs assessment, intervention planning, and outcome monitoring.

1.2. From the Pathological to the Multidimensional Perspective

The contemporary perspective on active ageing recognises that old age can involve changes in physical health, cognition, social relationships, and autonomy, but it also emphasises the possibility of adaptation, compensation, and meaningful participation [12].

In this perspective, health must be understood in a broad sense. It includes physical conditions, mental health, cognitive functioning, sleep quality, the ability to carry out daily activities, and the possibility of accessing health and social services. Participation includes family relationships, community engagement, cultural and recreational activities, volunteering, learning, and, for some people, work. Security concerns social protection, housing adequacy, availability of economic resources, safety of spaces, and the possibility of receiving assistance when needed [3,4,13].

The literature examined in the three articles shows that these domains are not independent. Physical functioning conditions the possibility of participating in social initiatives; economic difficulties can limit access to services, mobility, and technologies; cognitive decline can reduce the ability to use digital tools autonomously; social isolation can affect psychological well-being and motivation; the physical environment can facilitate or impede the performance of daily activities.

This leads to a conception of active ageing as a phenomenon emerging from the interaction between person and environment. The older person is evaluated based on the opportunities available, the resources that they have, the obstacles that they encounter, and the meaning that they attribute to their activities. This point is particularly important in the case of people with disabilities, chronic diseases, or cognitive limitations. Two people may perform the same number of activities, but one of them may have had to overcome much more relevant physical, cognitive, economic, or social obstacles. A measure that considered only the frequency of behaviours would not be able to adequately represent this difference [9,10].

1.3. Macro and Micro Levels of Assessment

Active ageing assessment tools can also be distinguished according to the level of analysis. At the macro level, the aim is to describe the conditions of a population, a territory, or an institutional system. At the micro (individual) level, instead, the interest concerns the position of the single person with respect to the different dimensions of active ageing [5].

An example of a macro measure is the Active Ageing Index (AAI) [14], developed to compare European countries. The index includes 22 indicators organised in four domains: employment; social participation; independent and secure living; capacity and enabling environment for active ageing. This type of indicator is useful for planning public policies, for comparing territories, and for identifying social inequalities. However, it is not conceived primarily to describe the individual experience of the older person, nor to directly guide a clinical or intervention of social support, e.g., [4,14].

Individual measures are more suitable for detecting perceived health, well-being, autonomy, activities carried out, participation, social support, and environmental resources, e.g., [5]. They can be used in research, in clinical practice, in local services, in residential facilities, and in health promotion programmes. Their use allows the construction of individual profiles useful for identifying needs, resources, and obstacles.

This distinction has relevant methodological consequences. A macro index can use administrative data, socioeconomic indicators, or population statistics, while an individual tool can be based on questionnaires, interviews, cognitive tests, behavioural observations,

or digital data. The choice of the level of measurement should therefore be consistent with the research question. It is not methodologically correct to use a national index to make individual care decisions, just as an individual questionnaire is not sufficient to evaluate the overall effectiveness of a regional policy, e.g., [4,15].

1.4. Heterogeneity of Available Measurement Tools

The scoping review conducted by Napoletano and colleagues identified 25 documents relating to questionnaires developed to measure active ageing or adapted and validated in other languages with a micro measurement approach. Twenty-one studies proposed a new questionnaire, while four concerned translations or adaptations of existing instruments. The search included scientific publications and grey literature, with a strategy based on Scopus, Web of Science, PubMed, PsycINFO, BASE, and OpenGrey. The final selection was conducted by two independent raters, with the involvement of a third rater to resolve disagreements [4].

One of the main results is the considerable terminological heterogeneity. The tools use different words to indicate the parts of the construct: "domains", "determinants", "factors", "dimensions", "components", or "sides". These terms are not necessarily equivalent. In some cases, they indicate distinct theoretical dimensions; in others, they simply describe groups of items organised according to practical criteria.

The definition of contents also varies considerably. Some tools focus on health, autonomy, and daily activities; others include psychological health, well-being, social relationships, economic security, learning, cultural participation, or the environment. In several questionnaires, generic categories such as "health" or "personal factors" simultaneously include physical and mental dimensions, making it difficult to understand which aspects are measured, e.g., [15–17]. Moreover, the heterogeneity of measurement tools undermines the validity of cross-study comparisons, rather than posing a mere classification problem. When two questionnaires use the same label (for example, "participation" or "health") but include different items, the scores may not represent the same construct. Similarly, two tools that use different dimensions can measure partially overlapping aspects without being directly comparable. Furthermore, "crosswalk" studies designed to compare and to link scores across disparate measurement instruments are resource-intensive and complex, and they are consequently relatively rare in the literature, e.g., [18].

To make the tools comparable, the scoping review grouped the contents into seven content areas inspired by the active ageing determinants proposed by the WHO's model [3]:

- Physical area, including mobility, physical efficiency, exercise, autonomy, and activities of daily living.
- Cognitive area, including attention, memory, learning, reasoning, decision-making, problem-solving, and language.
- Psychological and emotional area, including well-being, depression, anxiety, energy, loneliness, and satisfaction.
- Ecological area, including the relationship with natural environments and the opportunities offered by the context.
- Cultural area, including participation in cultural and educational activities.
- Economic area, including financial autonomy, economic security, income, and work activity.
- Social area, including relationships, social support, community participation, and maintenance of family and friendship ties.

This classification proved to be particularly useful for a multidisciplinary project of telemedicine and tele-support such as the AmICA project. This ensured a comprehensive assessment across multiple health domains, linking each outcome directly to the appropriate

level of intervention. For example, a difficulty in the physical area may require rehabilitation or medical support; a difficulty in the psychological area may require psychological tele-support; a difficulty in the social area may require network hybrid interventions, with humans and technological devices; a difficulty in the economic area may require the support of social services; a difficulty in the technological area may require digital training or interface adaptations.

1.5. The UJACAS as an Integrated Measure

Among the instruments examined in the scoping review, the UJACAS was identified as one of the most complete measures in terms of areas covered and availability of adapted versions [19–21]. The UJACAS is distinguished because it does not define active ageing exclusively through the frequency of activities performed. For each activity, it considers four components:

1. The will to act, referring to the desires, goals, and motivation of the person.
2. The ability to act, referring to the perceived capacities and the functional state necessary to carry out the activity.
3. The opportunity to act, referring to the environmental, social, and situational conditions that make the activity possible.
4. The activity, referring to the frequency or amount of behaviour performed.

The scale includes 17 items, corresponding to different activities typical of adult and older life. Each item is assessed through the four subscales, generally with a five-point Likert scale. In the version described by Napoletano and colleagues, each subscale can reach a maximum score of 68, and the total score can reach 272. Higher scores indicate higher levels of active ageing [12].

The structure of the UJACAS presents an important theoretical advantage: it separates observable behaviour from the conditions that make it possible. A person may wish to perform an activity but not feel able to do it; they may possess the necessary skills but not have access to an adequate environment; they may have opportunities and abilities but not be motivated; or they may actually participate in the activity in the presence of very difficult conditions [17].

This articulation is consistent with a conception of active ageing based on the relationship between person, behaviour, and context. It is also relevant for the design of interventions. A low score in activity frequency, accompanied by high willingness, suggests a different condition compared to a low motivational score. In the first case, the intervention could focus on the removal of barriers or the enhancement of capacities; in the second, it might be necessary to work on interests, the personal meaning of the activity, and social support [9,10].

1.6. Content Validity and Completeness of the Instrument

The scoping review included a specific evaluation of the content validity of the UJACAS. The aim was to verify which conceptual areas were represented by the items.

The analysis showed that most UJACAS items include more than one content area. Only five items appeared to refer mainly to a single area, while the others combined physical, cognitive, psychological, social, economic, cultural, or ecological aspects. This characteristic contributes to the richness of the instrument but also makes the interpretation of scores more complex [4]. An item relating to participation in a group activity, for example, may simultaneously imply mobility, motivation, social opportunities, organisational skills, and psychological well-being. A low score can therefore have different causes. If the questionnaire is used without further information, the researcher or professional may

not know whether to intervene on physical health, transport availability, social network, or motivation.

Furthermore, incorporating diverse content spanning four distinct dimensions within a single instrument can significantly increase the cognitive load for participants. This question is particularly important when assessing oldest-old individuals or populations presenting with sensory impairments, cognitive decline, fatigue, depression, or low digital literacy, where tool complexity and administration demands can confound assessment outcomes [22–24]. While comprehensiveness is essential, an assessment tool should not become excessively burdensome for the respondent. Therefore, in specific clinical or research settings, a stepped approach is preferable: the UJACAS can serve as a primary screening tool, integrated with domain-specific measures only when these important questions are detected.

2. Navigating Active Ageing Measurement Frameworks: Theoretical and Practical Insights

The perspective and methodological paper by Bosco and Lopez [9] signals a series of specific theoretical and psychometrics questions of the UJACAS: (a) Different versions use different ranges of scores. The difference may seem to be merely formal, but it affects the interpretation of scores, the comparability of distributions, and the definition of minimum and maximum values. (b) Translation does not consist in the simple linguistic substitution of words. Terms such as "will", "ability", "opportunity", "autonomy", and "participation" can assume different meanings in relation to culture, family structure, social policies, and the organisation of services. (c) In some contexts, the opportunity to act may depend mainly on the availability of transport and public services; in others, it may be determined primarily by family support. (d) Motivation can be interpreted as personal desire or as fulfilment of family or community expectations.

In sum, intercultural adaptation should therefore include at least translation and back-translation, evaluation by experts, cognitive interviews with older people, verification of item comprehensibility, and psychometric analyses in the new population. When the scale is used in digital or remote mode, it is also necessary to verify the equivalence among paper administration, telephone interview, video interview, and autonomous online completion.

2.1. Remarks on the Additive Model

The UJACAS is generally interpreted through an additive model in which the total score derives from the sum of the four subscales:

$$\text{AA (active ageing level)} = W + A + O + F$$

where W represents the will to act, A the ability to act, O the opportunity to act, and F the frequency of activity.

This model is simple and easily interpretable. It allows obtaining an overall score and comparing people or groups. However, additivity implies that the four components contribute in a substantially equivalent and compensable way. A low score in one component can be compensated by high scores in the others. Bosco and Lopez [9] question this property. An example concerns a person who declares not to perform an activity, assigning a value equal to zero to the frequency, but reports high ability and wide opportunity to perform it. With the additive sum, the item could still contribute positively to the overall score, despite the activity not being carried out. This situation produces an interpretative tension between the measure of preliminary conditions and the measure of actual behaviour.

A second challenge concerns people who carry out activities despite relevant limitations. If ability and opportunity are treated as internal components of the total score,

a person with disabilities can obtain a lower score compared to a person who performs the same number of activities in much more favourable conditions. The score thus risks reflecting mainly the availability of resources and the absence of barriers, rather than the ability to participate despite difficulties.

From this theoretical perspective, ability and opportunity may be considered to be hypothesised moderators of the relationship between motivation and activity [9]. This interpretation distinguishes actual participation from personal capacities and environmental conditions that may facilitate or constrain it. However, the canonical correlation analysis reviewed here examines associations between variable sets; it does not test whether the relationship between motivation and activity varies according to ability or opportunity [10]. The proposed moderation effects therefore remain unverified.

Future studies should directly test this hypothesis by modelling activity as a function of motivation, ability, and opportunity, together with motivation × ability and motivation × opportunity interaction terms. Each interaction should be evaluated alongside its constituent main effects, and supported interactions should be examined using conditional effects and their confidence intervals. Longitudinal designs with repeated assessments could test whether baseline ability and opportunity modify the association between motivation and subsequent activity, accounting for baseline activity and relevant covariates. Such designs could also examine whether changes in these conditions accompany changes in the motivation–activity relationship. These analyses would help distinguish the proposed moderator interpretation from alternative roles for ability and opportunity, including direct associations with activity.

This proposal does not necessarily imply that ability and opportunity should be excluded from the active ageing profile. It rather suggests avoiding that the global score hides the differences between "not participating because *one does not want* to do it", "not participating because *one is not able* to do it", and "not participating because *the environment prevents* it".

2.2. A Proposal for Fair and Context-Sensitive Measurement

Bosco and Lopez [9] propose considering personal and environmental limitations as factors capable of modifying the interpretation of activity frequency. In this perspective, the same behavioural frequency could have a different meaning depending on the conditions in which it is achieved. The proposal includes a model of correction of activity frequency based on ability and opportunity scores. The model also assigns a role to the relative weights of the two components, hypothesising that the weight of ability may be greater than that of opportunity in some contexts. The correction should be limited within a predetermined range, to avoid excessive variations by the original score. From a methodological point of view, this proposal is interesting because it introduces an equity criterion in measurement. Equity consists not in giving the same score to different people but in considering the different conditions that make the same behaviour possible or difficult. However, a correction of this type requires further empirical studies. The weights should not be chosen based only on clinical or theoretical intuition but should be estimated and verified on large and diversified samples. It would also be appropriate to compare at least three approaches:

1. The traditional additive total score.
2. A multidimensional profile without aggregation.
3. An adjusted/weighted score based on limitations and opportunities.

The comparison should examine reliability, predictive validity, equity between groups, sensitivity to change, and ability to guide interventions. Particularly, it would be necessary to verify whether the adjusted model better identifies people who maintain high participation despite disabilities, poverty, isolation, or environmental barriers.

3. The UJACAS and the COM-B Model

The most recent study by Napoletano and colleagues [10] proposes interpreting the structure of the UJACAS through the COM-B model, according to which behaviour derives from the interaction among capability, opportunity, and motivation [11]. In the model applied to active ageing, the ability to act can be associated with capability, the will to act with motivation, the opportunity to act with the enabling environment, and the activity with observable behaviour.

This interpretation does not mean that the subscales are identical to the COM-B constructs. Rather, their association has a theoretical function: it helps to distinguish the individual, motivational, and environmental conditions that contribute to participation. As mentioned above, this distinction can be useful both for analysis and for the design of interventions.

The study includes two sections: The first examines the Italian translation of the UJACAS and verifies whether the order of administration of the subscales influences the responses. The second analyses the relationships between ability and opportunity to act and external measures of functional limitation and environmental barriers.

The first section involved 76 older adults, matched for gender, age, and years of education, who received either the original subscale order or a version in which the order of ability and opportunity was reversed. No statistically significant differences associated with administration order were detected. This provides preliminary evidence concerning the specific order manipulation examined but should not be interpreted as demonstrating equivalence between administration orders or general stability of the UJACAS.

Given the relatively small sample, smaller order effects cannot be excluded. Moreover, this comparison does not establish test–retest reliability or the consistency of responses across populations, settings, or administration modes. The findings therefore leave open questions concerning possible confusion between ability and opportunity and the influence of item presentation [25,26]. Further research should assess item comprehensibility and administration-order effects using larger samples and designs specifically intended to evaluate equivalence.

External Evidence for Ability and Opportunity

The second section of the study included 74 older people and related the UJACAS subscales to the World Health Organization Disability Assessment Schedule (WHODAS 2.0) [27] and to the Environmental and Social Limitations in Aging Questionnaire (ESLA-Q), an ad hoc instrument [10]. The WHODAS 2.0 was used to detect difficulties in functioning and disability in domains such as understanding and communication, mobility, self-care, relationships, daily activities, and social participation [27]. The ESLA-Q included physical, social, and product and technology barriers.

Canonical correlation analysis examined associations between two variable sets: the UJACAS ability and opportunity subscales, and measures of functional limitations and environmental barriers. Two canonical functions were obtained, with correlations of 0.59 and 0.46. The overall two-function model was statistically significant (Wilks' $\lambda = 0.51$, $p < 0.001$). The corresponding value of $1 - \lambda = 0.49$ summarises the overall multivariate association; it should not be interpreted as 49% of the variance explained in the original measures.

Sequential testing supported the interpretation of the first function under the significance criterion adopted in the original study. Its squared canonical correlation was reported as $Rc^2 = 0.34$, indicating approximately 34% shared variance between the two canonical variates, rather than across the original measures. The second function had a reported p-value of 0.03 and was not retained for interpretation under that criterion [10].

In the first function, opportunity to act had the highest structure coefficient within the UJACAS set. Within the external-measure set, physical environmental barriers had the highest structure coefficient, followed by barriers involving products and technologies; WHODAS domains contributed less strongly [10,28]. This pattern provides preliminary evidence of an association between perceived opportunity and environmental conditions. It does not establish environmental causation or confirm a moderator role for opportunity. The second function does not provide sufficient support, under the study's criterion, for a separate interpretation linking ability to functional limitations. Given the sample of 74 older adults, these findings require replication in larger and more diverse populations.

These results have an important theoretical consequence. The participation of the older person cannot be interpreted only as an expression of personal capabilities and attitudes. Even in the presence of adequate physical and cognitive resources, participation can be limited by the quality of the environment, the safety of spaces, the availability of transport, the accessibility of services, social support, and the accessibility of technologies.

For a telemedicine and tele-support project, the technological dimension must be explicitly included in this reasoning. A digital service can increase the opportunities of access for a person with mobility difficulties but can become a new barrier for those who have visual/cognitive/economic problems or low familiarity with devices. Technology is therefore not automatically an opportunity.

4. Implications for Assessment at Different Levels of Functionality

The three articles suggest that the assessment of active ageing should be adapted to the person's level of functionality. The same tool can be useful in different populations, but not necessarily with the same mode of administration, the same meaning of scores, or the same complementary indicators.

In older people in conditions of well-being and autonomy, the UJACAS can be used to describe motivations, activities, interests, perception of capacities, and available opportunities. In this group, attention can be directed to prevention, promotion of physical activity, social participation, learning, and maintenance of cognitive resources. In people with chronic diseases, the assessment should distinguish between functional limitations, adaptation, motivation, and environmental barriers. A low level of activity can depend on the disease, but also on the possibility of modifying the activity, receiving assistance, or using technological tools. The multidimensional profile can therefore be more informative than a global score. After a hospital discharge, the assessment should include the transition between potential capacity and actual participation. A person may have recovered sufficient abilities to perform an activity but not yet have access to transport, family support, technologies, or local services. In this case, the "opportunity" component can identify modifiable obstacles and indicate objectives for remote monitoring and distance support.

Potential applications in older adults with cognitive impairment, sensory limitations, or functional dependency require caution. The psychometric findings reviewed here do not establish the validity of the UJACAS across these populations or under adapted administration conditions. Cognitive impairment may affect comprehension, recall, and the differentiation of willingness, ability, opportunity, and activity. Sensory limitations may hinder access to questionnaire content, while functional dependency may complicate the distinction between activities performed independently and those undertaken with assistance. These issues may affect both the responses obtained and the interpretation of scores.

Accessible presentation formats, interviewer assistance, simplified wording, caregiver involvement, and observational measures are possible approaches for future investigation within AmICA. However, assistance that enables an older person to provide their own answers should be distinguished from proxy reporting, in which another person answers

on their behalf. Caregiver reports and observations may complement self-report, but their equivalence to UJACAS responses has not been established, particularly for subjective components such as willingness and perceived opportunity. Changes to wording, response formats, or reporting source require dedicated evaluation of comprehensibility, reliability, validity, burden, and comparability with standard administration. Until such evidence is available, adapted assessments should be treated as investigational, and their scores should not be assumed to be interchangeable with standard UJACAS scores. Once the target content domain for active ageing is defined, future research could benefit from a multi-method framework designed to capture the different facets of the phenomenon. In this context, combining self-report assessments with the aforementioned proxy evaluations (e.g., family or caregiver reports) and expert-based behavioural observations represents a robust approach. Nevertheless, adopting such a comprehensive multi-method design inevitably entails a significant increase in financial and operational costs compared to single-method evaluations.

Towards an Integrated Assessment System

Overall, the three works converge on a methodological conclusion: active ageing should not be evaluated by means of a single non-contextualised indicator. It is preferable to build an integrated system capable of combining subjective, functional, environmental and behavioural measures.

A possible assessment architecture could include four levels:

- Behavioural level, relating to the activities carried out and their frequency.
- Motivational and psychological level, relating to desires, goals, well-being, perceived autonomy, and meaning attributed to activities.
- Functional and clinical level, relating to health, cognition, mobility, daily activities, disability, and neuropsychiatric symptoms.
- Contextual level, relating to environmental barriers, social support, economic resources, accessibility of services, and availability of technologies.

To these levels should be added an educational and digital assessment. In fact, the use of telemedicine services requires competencies, trust, digital literacy, availability of devices, and support for use. A person could have high motivation and good functional capacity but not be able to benefit from a remote intervention if the platform is complex or if there is no family member who facilitates access.

In the multidisciplinary project considered, this setting allows linking the assessment to the personalisation of interventions. Psychometric tools should be used not only to produce a final score but to identify which mechanisms are favouring or limiting participation. The assessment procedure itself should therefore support the diagnosis of needs, the choice of intervention, monitoring over time, and the evaluation of outcomes.

For AmICA, this architecture would support a sequence of assessment, targeted investigation, personalised intervention, and reassessment. For example, low activity accompanied by high willingness and perceived ability would prompt further investigation of environmental or digital barriers, whereas low perceived ability would prompt a more detailed functional assessment. These profiles would inform, rather than determine, intervention choices, together with the older person's preferences and professional judgement. Reassessment would examine whether changes in the targeted conditions are accompanied by changes in actual participation. Within this approach, wearable and remote-monitoring data could complement self-reported activity but would not replace assessment of motivation, perceived ability, or opportunity. The feasibility, acceptability, and sensitivity to change of this integrated approach remain to be established, particularly in people with cognitive impairment or substantial support needs.

5. Limitations

This perspective selectively integrates three publications from an overlapping research group, rather than providing a systematic synthesis of all available evidence. Although one of these publications is a scoping review, the present integration may privilege instruments and theoretical interpretations. Future work should examine the proposed architecture against independent evidence and alternative approaches to active ageing assessment.

The empirical findings discussed here derive from relatively small samples of 76 and 74 older adults. Their generalisability to more diverse populations—particularly people with cognitive impairment, substantial sensory limitations, or functional dependency—remains uncertain. The absence of statistically significant administration-order differences does not establish equivalence or general instrument stability. Larger, independently recruited samples and dedicated validation of adapted administration procedures are therefore needed.

The reliance on self-reported measures and the partial overlap in scale content also constrain interpretation. Associations between UJACAS components and external measures may partly reflect shared reporting methods or similar item content, rather than independent evidence of construct validity. Future studies should combine self-report with appropriately validated observational, functional, and contextual measures, while examining whether these sources capture complementary information. Canonical correlation analysis does not establish causal relationships or moderation effects; the proposed roles of ability and opportunity as hypothesised moderators require direct interaction tests and longitudinal investigation.

In conclusion, the integrated assessment architecture has not been prospectively evaluated within AmICA. The reviewed evidence does not show that framework-guided remote support improves independence, social participation, access to care, or other clinical outcomes. Future evaluation should establish feasibility, acceptability, assessment burden, and usefulness for care decisions, followed by comparative studies of patient and service outcomes. These challenges define a research agenda for evaluating the proposal, rather than evidence of benefits already achieved.

6. Conclusions

The assessment of active ageing requires a clear theoretical definition and a selection of tools consistent with the purpose of the assessment. The available literature shows a marked heterogeneity in contents, terminology, levels of analysis, and validation procedures. This heterogeneity makes the comparison between studies difficult but also reflects the complex and multidimensional nature of the construct [29].

The UJACAS constitutes a particularly relevant contribution because it links the frequency of activities to motivation, personal capacities, and environmental opportunities. The scoping review highlights the completeness of its contents, the theoretical analysis points out its methodological challenges of standardisation and scoring, and the most recent empirical study detected no statistically significant differences between the administration orders examined and provided preliminary evidence of associations with functional limitations and environmental barriers; these findings require confirmation in larger and more diverse samples [4,9,10].

The conceptual synthesis presented here suggests that active ageing does not coincide with the simple number of activities performed. It is rather the result of the interaction between what the person wishes to do, what they can do, what the environment allows them to do, and what they manage to achieve. For this reason, an adequate assessment should be sensitive to individual differences, social inequalities, functional limitations, economic resources, and technological accessibility.

The contribution of this work is to propose a connection between multidimensional assessment and personalised intervention planning within AmICA. By distinguishing activity, motivation, perceived ability, and environmental opportunity, the framework could help identify needs requiring further assessment and inform the selection of support strategies. These potential applications should be distinguished from demonstrated clinical benefits. The evidence reviewed here does not establish that implementing this framework increases independence, reduces social isolation, improves access to care, or prevents avoidable hospital admissions. Prospective evaluation should examine its feasibility, acceptability, and usefulness for care decisions, followed by comparative studies assessing patient and service outcomes. Supporting independence and participation therefore remains an objective of AmICA whose achievement requires direct evaluation.

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Abbreviations

The following abbreviations are used in this manuscript:

UJACAS	University of Jyvaskyla Active Aging Scale
WHO	World Health Organization
COM-B	Capability, Opportunity, Motivation-Behaviour
AHA	Active and Healthy Ageing
IoMT	Internet of Medical Things
AAI	Active Ageing Index
ESLA-Q	Environmental and Social Limitations in Aging Questionnaire
WHODAS	World Health Organization Disability Assessment Schedule

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