

Physical Activity, Participation and Self-Rated Health Among Older Community-Dwelling Icelanders

A Population-Based Study

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Rismál

... ennpá sumar ... dalalæða ... engjarnar regnvotar ...
í morgunsárið ... mjólkurbíllinn á hraðferð ... í hættu-
legri beygju ... bæjarnafn á brotnu skilti ... kot ...
sláturfé á beit ... hvað svo? ... hrafn bíður átekta
... ekkert á seiði ... í heiðinni gera haustlitirnir vart
við sig ... ljóst hvað tímanum líður...

Dawn

... still summer ... low fog ... the rain-wet meadows ...
at first gleam of daylight ... the milk truck racing ...
a dangerous bend ... a farm's name on a broken sign
... cottage ... sheep grazing ... what then? ... a raven
biding its time ... nothing happening ... on the moor
the autumn colours make themselves felt ... clear
how time is passing...

Dags att stiga upp

... ännu sommar... dimma ... ängarna våta av regn ...
tidig morgon ... mjölkbilen i full fart ... i en farlig
kurva ... ett gårdsnamn på en trasig skylt ... ett torp ...
slaktfår på bete ... vad mer? ... en korp ser tiden an
... inget i görningen ... på fjällheden ger sig höstfärgarna
till känna ... det är uppenbart att tiden lider ...

Aðalsteinn Ásberg Sigurðsson

*From the book of poetry: Draumkvæði, 1992.
English translation: Bernard Scudder
Svensk översättning: Inge Knutsson*

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ABSTRACT

Background: The main objective of this study was to investigate older people's physical activity, their participation in various life situations, and their perceptions of their own health. This included an exploration of potential influences of urban versus rural residency on these outcomes, an evaluation of the measurement properties of a balance confidence scale, and an examination of the proposed usefulness of the International Classification of Functioning, Disability and Health (ICF) as a conceptual framework to facilitate analysis and understanding of selected outcomes.

Methods: The study design was cross-sectional, population-based, with random selection from the national register of one urban and two rural municipalities in Northern Iceland. There were 186 participants, all community-dwelling, aged 65 to 88 years (mean = 73.8), and 48% of the group were women. The participation rate was 79%. Data was collected in 2004, in face-to-face interviews and various standardized assessments. The main outcomes were total physical activity; leisure-time, household, and work-related physical activity; participation frequency and perceived participation restrictions; and self-rated health. Other assessments represented aspects of the ICF body functions, activities, environmental factors and personal factors. Rasch analysis methods were applied to examine and modify the Activities-specific Balance Confidence (ABC) scale. The ICF was used as a conceptual framework throughout the study.

Results: The total *physical activity* score was the same for urban and rural people and the largest proportion of the total physical activity behavior was derived from the household domain. Rural females received the highest scores of all in household physical activity and rural males were more physically active than the others in the work-related domain. However, leisure-time physical activity was more common in urban than rural communities. A physically active lifestyle, urban living, a higher level of cognition, younger age, and fewer depressive symptoms were all associated with more *frequent participation*. Rural living and depressive symptoms were associated with *perceived participation restrictions*. Moreover, perceived participation restrictions were associated with not being employed and limitations in advanced lower extremity capacity. Fewer depressive symptoms and advanced lower extremity capacity increased the likelihood of better *self-rated health*, as did capacity in upper extremities, older age, and household physical activity. Rasch rating scale analysis indicated a need to modify the ABC to improve its psychometric properties. The modified ABC was then used to measure *balance confidence* which, however, was found not to play a major role in explaining participation or self-rated health. Finally, the *ICF* was useful as a conceptual framework for mapping various components of functioning and health and to facilitate analyses of their relationships.

Conclusions: The results highlighted the commonalities and differences in factors associated with participation frequency, perceived participation restrictions, and self-rated health in old age. Some of these factors, such as advanced lower extremity capacity, depressive symptoms, and physical activity pattern should be of particular interest for geriatric physical therapy due to their potential for interventions. While the associations between depressive symptoms, participation, and self-rated health are well known, research is needed on the effects of advanced lower extremity capacity on participation and self-rated health in old age. The environment (urban versus rural) also presented itself as an important contextual variable to be aware of when working with older people's participation and physically active life-style. Greater emphasis should be placed on using Rasch measurement methods for improving the availability of quality scientific measures to evaluate various aspects of functioning and health among older adults. Finally, a coordinated implementation of a conceptual framework such as ICF may further advance interdisciplinary and international studies on aging, functioning, and health.

Keywords: Aging; older people; physical activity; participation; self-rated health; balance confidence; rural; urban; residence; International Classification of Functioning Disability and Health (ICF); Rasch measurement; standardized assessment

SVENSK SAMMANFATTNING

Bakgrund: Huvudsyftet med avhandlingen var att undersöka vilka fysiska aktiviteter äldre personer utför samt att undersöka de faktorer som har betydelse för om äldre är delaktiga i olika typer av aktiviteter och för hur de upplever sin hälsa. Ett fokus var att studera eventuella skillnader i resultat mellan personer som bor i tätort jämfört med i glesbygd. Som en del i avhandlingen ingick utvärdering av mätetegenskaperna hos en skala för upplevd balans och av nyttan av den internationella klassifikationen av funktionstillstånd, funktionshinder och hälsa (ICF) som övergripande begreppsram.

Metod: Deltagarna i denna populationsbaserade tvärsnittsstudie valdes slumpmässigt från det nationella registret för en tätort och två glesbygdsområden i norra Island. Sjuttionio procent av de tillfrågade deltog. De 186 deltagarna var mellan 65 och 88 år (medelvärde = 73,8 år) och 48% av dem var kvinnor. Data samlades in med standardiserade frågeformulärer och tester vid hembesök under 2004. Huvudresultaten mättes med instrument för 1) fysisk aktivitet: totalt samt uppdelat på fritid, hushålls- och yrkesarbete, 2) frekvens av delaktighet i olika aktiviteter samt upplevda begränsningar i att kunna delta i dessa aktiviteter och 3) upplevd hälsa. Andra bedömningar som gjordes utgick från ICFs kroppsfunktioner och aktiviteter samt från omgivnings- och personliga faktorer. Dessutom användes Rasch-analys för att undersöka och modifiera "Activities-specific Balance Confidence scale" (ABC), en skala för upplevd balans.

Resultat: Graden av fysisk aktivitet låg på samma nivå för deltagare från både tätort och glesbygd. Den största andelen fysisk aktivitet var förknippad med hushållsarbete. Kvinnor i glesbygd var mer fysiskt aktiva i hushållet och män i glesbygd mer fysiskt aktiva i arbete än övriga. Fysisk aktivitet under fritiden var vanligare i tätort än i glesbygd. Ett mer frekvent deltagande i olika typer av aktiviteter var förknippat med en fysiskt aktiv livsstil, boende i tätort, bättre kognition, lägre ålder och färre depressiva symtom. Endast två av dessa faktorer, boende i glesbygd och fler depressiva symtom, var också förknippade med upplevda begränsningar i att kunna delta i dessa aktiviteter. Andra faktorer förknippade med upplevda begränsningar var att inte ha ett arbete och avsaknad av mycket god rörelseförmåga (avancerad kapacitet) i benen. Färre depressiva symtom och avancerad kapacitet i benen, god kapacitet i armar och händer, högre ålder samt en hög grad av fysisk aktivitet i hushållsarbete ökade sannolikheten för bättre upplevd hälsa. Skalan för upplevd balans, ABC, modifierades för att förbättra mätetegenskaperna. Graden av tillit till den egna balansen spelade dock inte någon större roll vare sig för delaktighet eller för upplevd hälsa. ICF bedömdes vara användbar för att underlätta analys och förståelse av komplexa samband mellan äldre personers karaktäristika och den omgivning som de bor i.

Slutsatser: Avhandlingen belyser faktorer av betydelse för delaktighet i olika typer av aktiviteter och för upplevd hälsa hos äldre personer. Ett viktigt fynd är att bedömningen av delaktighet bör innefatta både frekvens av olika aktiviteter och upplevd begränsning i att kunna delta i dessa aktiviteter med tanke på att det i huvudsak är olika faktorer som är förknippade med de två aspekterna av delaktighet. Resultaten som visar att depressiva symtom, avancerad kapacitet i benen och det fysiska aktivitetsmönstret är förknippade med både delaktighet och upplevd hälsa är särskilt viktiga för sjukgymnastisk prevention och behandling eftersom dessa variabler är påverkbara. Det är känt sedan tidigare att färre depressiva symtom är relaterade till bättre upplevd hälsa och mer delaktighet men att det samma gäller för avancerad kapacitet i benen har inte berörts i tidigare forskning. Vidare stödjer resultaten att omgivningen i form av tätort eller glesbygd är en faktor som är förknippad med det fysiska aktivitetsmönstret och delaktighet bland äldre personer. En ökad användning av Rasch-analys och av ICF kan utveckla forskning inom äldre området såväl interdisciplinärt som internationellt.

ÍSLENSK SAMANTEKT

Bakgrunnur: Meginmarkmið þessarar rannsóknar var að skoða daglega hreyfingu eldri borgara, þátttöku þeirra í ýmsum einstaklingsbundnum og félagslegum athöfnum, og mat þeirra á eigin heilsu. Þetta meginmarkmið fól að auki í sér að: (1) kanna möguleg áhrif búsetu í þéttbýli eða dreifbýli á hreyfingu, þátttöku og sjálfsmat á heilsu, (2) rannsaka próffræðilega eiginleika ABC jafnvægiskvarðans (Activities-specific Balance Confidence scale) til að meta öryggistilfinningu við athafnir daglegs lífs og (3) skoða notagildi Alþjóðlegs flokkunarkerfis um færni, fötlun og heilsu (ICF) við að greina gögn og túlka niðurstöður rannsóknarinnar.

Aðferð: Gerð var þversniðsrannsókn byggð á slembiúrtaki úr þjóðskrá yfir eldra fólk í dreifbýli og þéttbýli á norðanverðu Íslandi. Þátttakendur voru 186, búsettir í heimahúsum (utan stofnana), á aldrinum 65 til 88 ára (meðalaldur = 73,8 ár) og 48% hópsins var konur. Þátttökuhlutfall var 79%. Þátttakendur voru teknir tali, á árinu 2004, og notaðar staðlaðar spurningar og matstæki. Meginbreytur rannsóknarinnar voru heildarhreyfing í daglegu lífi, hreyfing í tómstundum, hreyfing við heimilisstörf og atvinnutengd hreyfing. Ennfremur þátttaka og takmarkanir á þátttöku ásamt mati á eigin heilsu. Einnig var lagt mat á ýmsa þætti sem töldust til líkamsstarfsemi, athafna, umhverfisþátta og persónuþátta ICF. Aðferðir Rasch voru notaðar til að greina próffræðilega eiginleika ABC jafnvægiskvarðans. Á öllum stigum rannsóknarinnar var hugmyndafræði ICF höfð að leiðarljósi.

Niðurstöður: Þegar á heildina var litið reyndist ekki munur á daglegri hreyfingu hjá eldra fólki í dreifbýli og þéttbýli, og áttu báðir hópar það sammerkt að heimilisstörf voru aðalvettvangur hreyfingar. Konur í dreifbýli hreyfðu sig þó mest af öllum við heimilisstörfin en hreyfing tengd atvinnu var algengust meðal karla í dreifbýli. Hreyfing í tómstundum var algengari í þéttbýli en dreifbýli. Meiri dagleg hreyfing, búseta í þéttbýli, vitræn færni, lægri aldur og færri þunglyndiseinkenni tengdust meiri þátttöku í ýmsum athöfnum. Þátttaka var á hinn bóginn *takmörkuð* hjá þeim sem bjuggu í dreifbýli, höfðu þunglyndiseinkenni, voru ekki í vinnu eða réðu illa við athafnir sem reyndu mikið á fótleggi. Færri þunglyndiseinkenni og það að ráða við athafnir sem reyna á bæði handleggi og fótleggi, hærri aldur og hreyfing við heimilisstörf juku hinsvegar líkurnar á góðu *mati á eigin heilsu*. Rasch-greining gaf til kynna þörf á að breyta *ABC jafnvægiskvarðanum* til að bæta próffræðilega eiginleika hans. Niðurstöður mælinga með ABC gegndu þó ekki viðamiklu hlutverki við að útskýra þátttöku eldri einstaklinga eða mat þeirra á eigin heilsu. ICF kom að góðum notum við að kortleggja undirþætti hreyfingar, þátttöku og sjálfmats á heilsu, og til að auðvelda greiningu á tengslum þeirra innbyrðis.

Ályktanir: Rannsóknin varpar nýju ljósi á tengsl þátttöku og sjálfsmats á heilsu við ýmsa grunnþætti sem lýsa öldruðum einstaklingum og umhverfi þeirra. Fram kom að mikilvægt er að meta þátttöku og takmarkanir á þátttöku í sitt hvoru lagi þar sem talsverður munur er á því hvaða þættir liggja þar að baki. Af þessum þáttum ættu líkamleg færni, þunglyndiseinkenni og dagleg hreyfing að vekja sérstakan áhuga öldrunarsjúkraþjálfara þar sem fyrri rannsóknir hafa sýnt hvernig hafa má áhrif á þá. Einnig benda niðurstöður á mikilvægi þess að taka tillit til búsetu þar sem þátttaka og hreyfing á efri árum koma við sögu. Leggja ber áherslu á að nota aðferðir Rasch-greiningar til að þróa og bæta stöðluð matstæki sem nýtast í vinnu með öldruðum og í öldrunarrannsóknum. Þá gæti hagnýting á hugmyndafræði og flokkunarkerfi ICF haft hvetjandi áhrif á þverfaglegar og alþjóðlegar rannsóknir á öldrun, færni og heilsu.

ABBREVIATIONS

ABC	Activities-specific Balance Confidence scale
ANCOVA	Analysis of Covariance
GDS	Geriatric Depression Scale
ICD	International Statistical Classification of Diseases
ICF	International Classification of Functioning, Disability and Health
LLFDI	Late-Life Function and Disability Instrument
LLFDI-D	Late-Life Function and Disability Instrument: Disability component
LLFDI-F	Late-Life Function and Disability Instrument: Function component
MMSE	Mini-Mental State Examination
OR	Odds ratio
OR _{adj}	Adjusted odds ratio
PASE	Physical Activity Scale for the Elderly
PASE-home	Physical Activity Scale for the Elderly – Scores obtained in household activities
PASE-leisure	Physical Activity Scale for the Elderly – Scores obtained in leisure-time activities (including walking as a way of transportation)
PASE-work	Physical Activity Scale for the Elderly – Scores obtained in work-related activities (paid or volunteer work)
SF-36	Short Form 36-item health survey
SRH	Self-rated health
TUG	Timed Up & Go test

DEFINITIONS

Activity	The execution of a task or action by a person and representing the individual perspective of functioning. Additionally, it is operationalized as an individual's capacity to execute a task or action in a standardized environment which can either be an actual environment (e.g. in capacity assessments in test settings) or an assumed environment (e.g. in self-reports on capacity) which can be thought to have a uniform impact. ¹
Assessment	An umbrella term for all assessments, independent of whether they are based on nominal, ordinal, interval or ratio scales.
Balance confidence	Refers to how confident a person is that he or she can maintain balance and remain steady when dealing with various environmental challenges encountered in daily life. ^{2,3}
Body functions	Physiological functions of body systems, including psychological functions. ¹
Community-dwelling	Living outside institutions.
Disability	An umbrella term for impairments, activity limitations, and participation restrictions. It denotes the negative aspects of the interaction between an individual (with a health condition) and that individual's environmental and personal contextual factors. ¹
Environmental factors	All aspects of the external world that form the context of an individual's life and, as such, have an impact on that person's functioning. Environmental factors include the physical world and its features, the human-made physical world, other people in different relationships and roles, attitudes and values, social systems and services, and policies, rules and laws. ¹
Functioning	An umbrella term for body functions, body structures, activities, and participation. It denotes the positive aspects of the interaction between an individual (with a health condition) and that individual's environmental and personal contextual factors. ¹
Health condition	An umbrella term for disease, disorder, injury, or trauma. It also includes aging. ¹

Measurement	A quantification of a construct, expressed in equal and additive units that represent the construct to be evaluated. ^{4,5}
Older	At least 65 years of age.
Participation	A person's involvement and performance in a real-life situation and representing the societal perspective of functioning. ¹ Participation includes engagement in personal tasks, such as personal self-care within the home, that are parts of social role expectations and inherent in the older person's family and social lives. ⁶
Personal factors	The particular background of an individual's life and living such as age, gender, past experience, other health conditions, lifestyle, and education. ¹
Physical activity	Any bodily movement produced by skeletal muscles that results in energy expenditure ⁷ whose magnitude is based on (1) the movement's intensity within a certain activity period, (2) the duration of the activity period, and (3) how frequently these activity periods occur. ⁸ Key issues in this thesis are to highlight physical activity as a lifestyle and therefore to base its assessment on the assumption of mundane activities and the regularity of the activity periods.
Population-based	Pertains to a general population defined by geopolitical boundaries; this population is the denominator and/or the sampling frame. ⁹
Rural area	A sparsely settled place (more than 200 meters between houses), away from the influence of large cities and towns, where people live on farms, in other isolated houses or in villages with no more than 25 inhabitants, and at least 2/3 of the population lives off of farming. ^{10,11}
Standardized	Pertains to a scale or an assessment that is administered, scored, and implemented according to a standard protocol and has been evaluated for psychometric properties. ¹²
Urban area	An area with at least 200 inhabitants, no more than 200 meters between houses, and at least 2/3 of the population earn their living from sources other than farming. ^{10,11}

ORIGINAL PAPERS

This thesis is based on the following papers:

- I Arnadottir SA, Gunnarsdottir ED, Lundin-Olsson L. Are rural older Icelanders less physically active than those living in urban areas? A population-based study. *Scand J Publ Health*. 2009;37:409-17.
- II Arnadottir SA, Lundin-Olsson L, Gunnarsdottir ED, Fisher AG. Application of Rasch analysis to examine psychometric aspects of the Activities-specific Balance Confidence scale when used in a new cultural context. *Arch Phys Med Rehabil*. 2010;91:156-63.
- III Arnadottir SA, Gunnarsdottir ED, Stenlund H, Lundin-Olsson L. Participation frequency and perceived participation restrictions at older age: applying the International Classification of Functioning, Disability and Health (ICF) framework. *Submitted*.
- IV Arnadottir SA, Gunnarsdottir ED, Stenlund H, Lundin-Olsson L. Self-rated health: a valid outcome in geriatric physical therapy? *Submitted*.

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INTRODUCTION

All over the world, the population of older people has been growing rapidly and future projections are predicting a continuing extension in life expectancy.¹³ Larger populations of older people are widely believed to increase the absolute number of people in poor health and with disabilities. To counteract such a trend, however, finding ways to optimize health and well-being in old age is a major concern. Physical therapists and other professionals within the field of aging need to join in preventive efforts and interventions directed towards the myriads of potentially modifiable aspects of poor health and disability. An essential foundation for optimal implementation of such efforts is in-depth knowledge of the building blocks of health and disability,¹⁴ with full inclusion of the contextual factors in older persons' lives.

Aging in Iceland

The demographic development of the Icelandic nation has been lagging behind some of its neighbor countries in terms of population aging, with a lower average age of the population and lower old age dependency ratios. However, this situation is predicted to change rapidly in the years to come when larger cohorts with extended life expectancies will join the group of older Icelanders.

The older population

The proportion of people who have reached 65 years of age is rapidly growing in most parts of the world. In 2004, when this research project started, Icelanders who had reached 65 years of age accounted for 11.7% of the nation¹⁰ as compared to 17.3% in Sweden, 12.4% in the US, and 13.8% on average for the Organization for Economic Co-operation and Development (OECD) countries.¹⁵ The average age (35.5 years) and old age dependency ratio (20% = 5 persons aged 20 to 64 years for every older person) are also relatively low in Iceland compared to other OECD countries.¹⁶ Icelandic statistics from 2010 show the proportion of 65 years and older people is now almost 12% and a population projection predicts the proportion to rise sharply in the years to come and to reach 23% in 2050 (Figure 1).^{10,16}

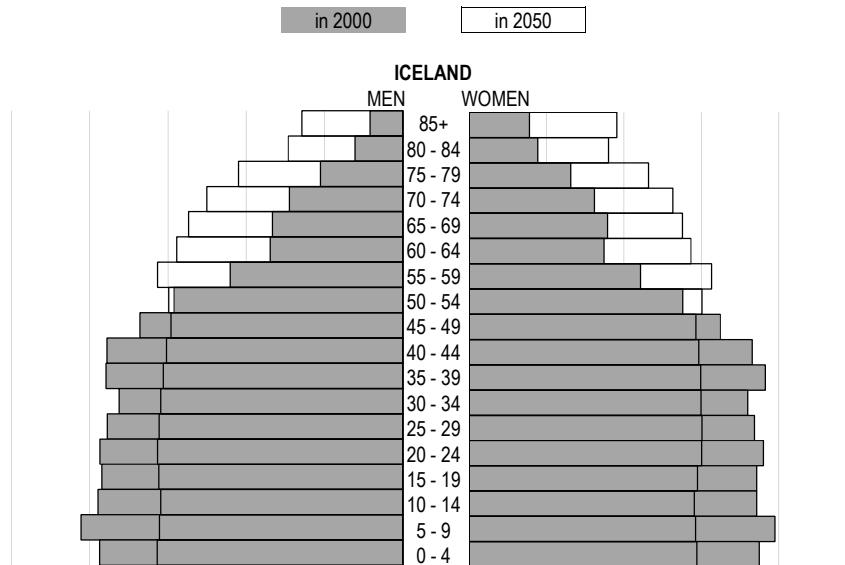


Figure 1. The Icelandic population by age group and gender, in 2000 and 2050. Source: Published with permission from OECD.¹⁶

In 2004, Icelandic women had an average life expectancy of 82.8 years at birth and 20.6 years at 65 years of age. Icelandic males had an average life expectancy of 78.9 years at birth and 17.8 years at the age of 65.¹⁰ Of those who had reached 65 years of age approximately 90% were community-dwelling and 10% lived within institutions for older people. The institutionalized population consisted mostly of the oldest-old people and the majority were women.¹⁰

The Icelandic context

Iceland is located between mainland Europe and North America. It reaches furthest west of the European countries and belongs also to the Northern Arctic part of the world (Figure 2). The culture is Western, the population is a fairly homogeneous ethnically and socioeconomically, and the health care and educational systems are nationalized. The national language is Icelandic and the literacy rate is among the highest in the world.¹⁰



Figure 2. Iceland in global context viewed from the North Pole. Source: Published with permission from UNEP/GRID-Arendal (<http://maps.grida.no/go/graphic/arctic-map-political>, cartographer Hugo Ahlenius).

Although the island is large, with an area of 103,000 km², only one fourth of the land is vegetated and the total population is only 300,000.¹⁰ Therefore, Iceland is the most sparsely populated country in Europe.¹⁷ According to Statistics Iceland, about 60% of the population lives in the capital, Reykjavík, and surrounding localities.¹⁰ The other 40% of the nation lives in towns, villages, and rural areas along the coastline. Approximately half of this group, or 20% of the Icelandic nation, lives in rural areas where the average age is usually higher than in urban areas.

Along with the aging of the population and rising old age dependency ratios, there is an increasing debate in Western societies about raising retirement ages and enabling people to work longer.¹³ In Iceland the general retirement age is 67 years, when the State Social Security Institute begins paying old age pensions. The effective retirement age, however, is around 65 to 66 years among women but higher among men or 68 to 69 years of age.¹⁸ In a governmental report, the employment participation

among middle and older age Icelanders was described as very high compared to other Western societies.¹⁹ According to this report, 44% of Icelandic men who had reached 65 years of age were in the labor market in 2002 compared to 5% in Denmark and Finland. Moreover, over 80% of 50 to 69 years old Icelanders participated in the labor market compared to 40% to 60% in most of the OECD countries.

Disability and health in old age

Growth of the older population is widely believed to increase the number of older people in poor health and with disabilities²⁰⁻²² which can mean difficulty or dependency in carrying out daily self-care activities, living independently in a home, and fulfilling social roles. Therefore, poor health and disability can decrease quality of life, and increase the need for home services, hospitalization, nursing home admission, and the risk of premature death.²³

Trends in populations

Among aging populations, trends in disability and poor health are of particular concern.¹³ Different theories have been put forth to shed light on such trends. The most pessimistic theory is on *expansion of morbidity* where it is argued that increased length of life means that more years are spent in poor health and with disabilities as people are living longer with chronic medical conditions and with an increasing burden of age-related diseases such as dementia.²⁴ A more optimistic view is presented in the theory on *compression of morbidity* where increased longevity is linked to fewer medical conditions and less disability due to improvements in preventive approaches and interventions.²⁵ A theory of *dynamic equilibrium*, however, relates increased longevity to a decreased prevalence of severe disabilities and medical conditions, yet an increase in minor disabilities and medical conditions.²⁶ Data from 12 OECD countries, where Iceland is not included, show that the trend in health conditions and disabilities varies between countries,¹⁵ with all three theories being supported in certain contexts. These mixed results, varying by country, do support, for example, the importance of the environmental context to health and disability. They also call for more research to explain the differences, preferably in a way that supports development of preventive and intervening efforts in the countries where poor health and disabilities have been on the rise among the older population.

Older people, however, are at the highest risk of all to have poor health and disabilities^{27,28} and all over the world there is an absolute increase in this at-risk population.²⁷ Therefore, even the most optimistic prognoses foresee an absolute increase in resources needed to maximize health and well-being in old age.^{13, 29}

Although Icelandic research on aging has increased in recent years, the main focus of published studies has been on the population in the capital area of Iceland (Reykjavik), the biomedical sides of aging, and aging in institutions.^{30,31} An effective disability prevention, however, requires a continuing national disability monitoring program based on an improved understanding of the causes of disabilities and associated risk factors.^{32,33} Such disability statistics have not been available for older community-dwelling Icelanders.

Definitions and conceptual frameworks

What do these concepts, disability and health mean? Both of them are complex in nature and researchers and health care professionals are far from being unanimous as to who is healthy or who has disability as existing theoretical frameworks have defined these concepts in different ways. Yet, within an aging population it is important to identify and understand these phenomena and the myriad of factors that are associated with health and disability in old age.

Health

The World Health Organization (WHO) has defined health as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” since 1946.³⁴ Prior to this date, health was generally considered to be the absence of disease.³⁵ In recent decades, with the acknowledgment of the importance how a person is tackling daily life, health has also been expressed as the individual’s capacity and performance as a participating member in society.³⁵ These broad building blocks of health also emerged in a qualitative study on 69 to 87 year old Icelanders.³⁶ The participants described their experience of health as maintaining physical and mental capacity, finding meaning and joy in life, having good relationships, being active in the society, being able to manage their own health, and keeping their dignity. They also described how advanced age had made them value health more, and how they had redefined their perceptions of health in the light of different life experiences including diseases and functional limitations. These definitions and descriptions of health embrace the idea that health is based on multiple factors which are related to the person and his or her living context.

Disability

Similar to health, disability used to be defined as a characteristic of the person, a consequence of a disease, and without any linking to the environment. A person with any significant impairment was labeled as disabled or handicapped. The role of environmental factors in the disability process has, however, gradually worked its way into the

definition of disability since the emergence of the disability rights movement in the 1960s.³⁷

Behind this shift in focus stand two major conceptual models of disability, the biomedical model and the social model. The *biomedical model* sees disability as an attribute of the individual, directly caused by disease, trauma, or other health condition.¹ The *social model*, however, views disability as a solely socially created problem.¹ To date it is widely agreed that neither of these models is adequate, on its own, to describe such a complex phenomenon as disability. Through ongoing synthesis and much debate, *biopsychosocial models* have been created, integrating the medical and the social models.³⁷

The foundation of biopsychosocial models may be traced to 1965 when American sociologist Saad Nagi introduced his conceptual framework of disablement.³⁸ There he distinguished between active pathology, impairment, functional limitation, and disability. In this context Nagi related disability to the social consequences of the gap between a person's abilities and the environment's requirements. His initial concept, which is referred to as *Nagi's disablement* model, was later extended further by Pope and Tarlow³² and Verbrugge and Jette.³⁹

In 1980, the World Health Organization (WHO) published the *International Classification of Impairments, Disabilities and Handicaps (ICIDH)*.⁴⁰ This manual of classifications relating to the consequences of diseases was developed as the approaches used in the International Classification of Disease (ICD) were found to be inadequate. In the conceptual framework behind this classification, WHO took the first steps in an attempt to incorporate the environment into the understanding of disability. The main concepts in the ICIDH model, however, were disease or disorder, impairment, disability, and handicap. Within this context, disability was conceptualized as any restriction or lack of ability (resulting from an impairment) to perform an activity in the manner or within the range considered normal for a human being.⁴⁰ Although this model became heavily criticized for lack of conceptual clarity and biomedical view, it introduced for the first time a classification system of different dimensions of the bodily, individual, and social consequences of disease and trauma.³⁷

In 2001, the World Health Organization published a major revision of the ICIDH.¹ This new framework was named the *International Classification of Functioning, Disability and Health (ICF)*. Its official aim was to provide a unified and standard language, definitions, and conceptual framework for the description of health and health-related states from a biopsychosocial point of view. To facilitate worldwide acceptance and cross-cultural applicability, the revision process was based on a general and global agreement that involved various interested parties, including people with disabilities.^{1,37} In ICF, the definition of disability has been broadened to become an umbrella term for impairments, activity

limitations, and participation restrictions. It presents the negative aspects of the interaction between an individual (with a health condition) and that individual's contextual factors (environmental and personal factors).

The Nagi's, ICIDH, and ICF models all have a conceptual scheme that is organized around some basic components. What has caused much confusion in the literature and in praxis is how these theoretical models use similar terms, yet define them in unique ways (Figure 3). For example, these models present unlike terms to describe how a person functions in a social context. Where Nagi uses disability, ICIDH has handicap, and ICF participation. Although the terminology of the ICF is not the same as in Nagi's model, it has been reasoned that the basic concepts within these frameworks are quite similar.^{41,42}

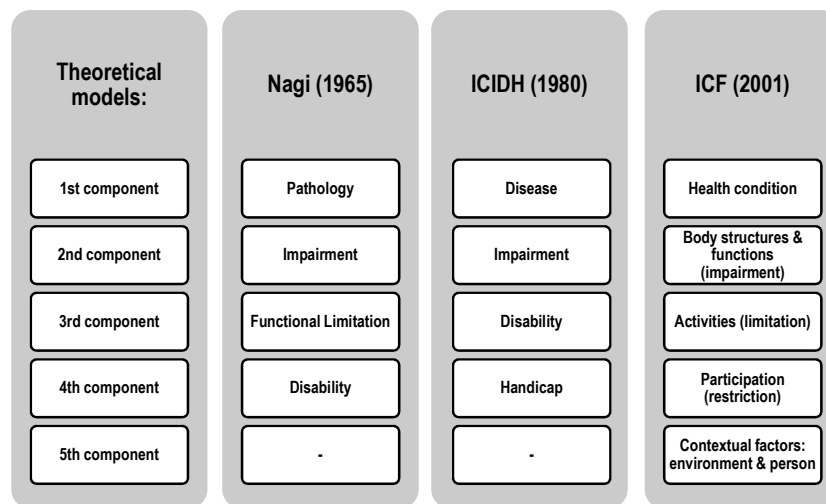


Figure 3. Names of the conceptual components of three theoretical models defining disability.

The lack of universally accepted and understood terms and concepts for describing and discussing disability and health has been a major barrier in research on contributing factors and potential interventions to prevent, decrease, or reverse disability³³. This “terminological soup” related to studies on disability and health has created multiple opportunities for misunderstandings.⁴³

There has been an ongoing debate on what should be the common international language when studying late-life disability and health.⁴⁴ Although the U.S. gerontological community is still favoring Nagi's Disablement Model⁴⁵ consensus regarding the use of ICF within the field of aging worldwide has strengthened in recent years.^{15,33,41,42} In 2003 the World Confederation for Physical Therapy recommended the implementation of the ICF⁴⁶ and in 2008 the American Physical Therapy

Association also officially endorsed the ICF as a conceptual framework to be integrated into physical therapist practice.⁴⁷

To facilitate the research process and for the description and understanding of health and disability, we selected the ICF model as a conceptual framework in our study. The differences between the ICIDH and ICF demonstrate well how views on health and disability have changed in a comparatively short time. Two of the key changes are the increased focus on environmental context, and a shift in language from negative terms to neutral terms, such as ICF's participation instead of ICIDH's handicap. The neutral terminology within ICF makes it possible to apply the ICF to everyone, including those in good health. Also, the ICF's inclusion of contextual factors makes it possible to identify environmental and personal barriers or facilitators for functioning. A detailed description of the ICF can be found elsewhere¹ along with discussions on its strengths and shortcomings.^{33,41,42,44,45}

In brief, ICF contains classifications and codes for multiple health and health-related categories that are the building blocks of the main components of ICF.¹ Figure 4 presents these main components of the ICF conceptual framework and the arrows represent their hypothesized interrelationships. The ICF framework is based on two main parts (Parts 1 and 2 in Figure 4), including components and categories (not shown) that are classified within the ICF.¹ The third part is the health conditions component, whose categories are classified within the ICD. Part 1 of the ICF, designated Functioning and Disability, includes the products of an interaction between a health condition and environmental and personal contextual factors. This interaction can occur at the level of the body, the person or the society. Depending on the level and the nature of that interaction the result can be either positive, and result in increased functioning through body functions and structures, activities and participation, or negative and result in disability through impaired body functions and structures, activities limitations or participation restrictions. Part 2 of the ICF is named Contextual Factors and includes two components called environmental factors and personal factors. Although health is not visible in the diagram, ICF describes health as a complex product of interactions between these health and health-related components.

In practice, ICF is used to systematically group and explore different health and health-related components for a person in a given health condition. Although the health condition often refers to a diagnosis as defined and coded in ICD, it also includes the phenomena of aging.¹ Physiological aging can be described as a process that contributes to a portion of disability in advanced age, independent of pathology or chronic disease and injury.⁴⁸ In our study aging was the health condition in focus. Any diseases or disorders the participants may have had were categorized as other health conditions within the personal factors component. Therefore, within the scope of this research a person's functioning and

disability was conceived as a dynamic interaction between the aging and the individual and contextual factors.

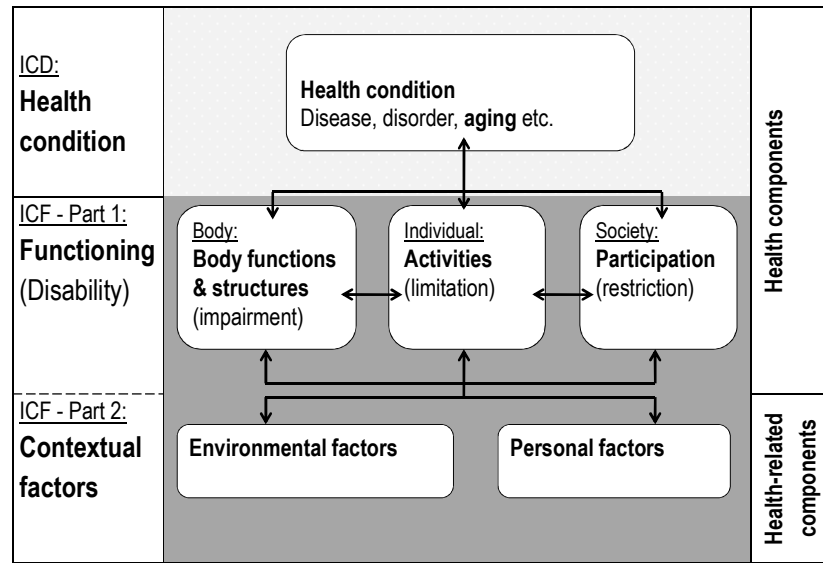


Figure 4. International Classification of Functioning, Disability and Health (ICF) Model. ICD = International Classification of Disease. Source: Adapted from World Health Organization, 2001¹

Finally, two of the shortcomings in the ICF should be noted^{1,33} as they had to be dealt with in this thesis. First, the domains for personal factors have not been developed, which has left this component open to much debate and uncertainty. Second, the ICF presents basic definitions of participation as “a person’s involvement in a life situation” and activities as “an execution of a task or action by a person”.¹ However, as the ICF developers did not reach a consensus regarding a clear conceptual differentiation between activities and participation they invited ICF users to differentiate activities and participation in their own operational ways. Therefore, in using the ICF, participation and activities share a list of categories without clear information on how these categories should be shared between these two concepts.

Functioning and health in old age

The ICF framework has highlighted the importance of environment and participation in research on functioning and health in old age. These concepts, environment and participation, form the main frame of this thesis along with a physically active lifestyle, confidence in maintaining balance in daily life, and self-rated health.

Urban versus rural environment

Paying more attention to the environment and the person-environment interactions is among the main challenges within current research on aging and health.⁴⁹⁻⁵¹ “Whether we recognize it or not, the environment constitutes the driving force of change. It is fundamentally historical and anchored in reality.”^{37(p.187)}

One of the most obvious environmental factors in the life of an older person is his or her place of residency. Comparing the populations in urban and rural areas often reveals that the proportion of older people is higher in the rural areas. This difference may be traced to: (1) *aging in place*, and refers to when adults turn 65 and remain in their current place of residence; and (2) *outmigration*, which refers to when rural youth move from rural areas and relocate in urban locations.⁵²

Clear definitions of what characterizes urban and rural areas are often lacking in the literature,⁵³ which makes comparisons difficult. In this thesis a rural area is defined as a sparsely settled place (more than 200 meters between houses), away from the influence of large cities and towns, people live on farms, in other isolated houses or in villages with no more than 25 inhabitants, and at least 2/3 of the rural population lives off of farming.^{10,11} An urban area is defined as an area with at least 200 inhabitants, no more than 200 meters between houses, and at least 2/3 of the urban population earn their living from sources other than farming.^{10,11}

Living rurally has been associated with many negative factors such as poor health and disability, less physically active behavior, less education, lower income, isolation and more physical obstacles arising from the environment and climate.^{54,55,56} However, positive sides of rural living should also been presented. Rural areas may also constitute appealing physical activity venues for older adults with recreational opportunities such as hiking and horseback riding. In a major review on the life of older farmers, authors highlight that many older farmers are contributing much to their communities and nations through economic, social, and cultural capital.⁵⁷ They also describe how the large majority of older farmers continue to work well past an official retirement age. Additionally, research on cognition in older Icelanders showed that older people from a rural agricultural area performed significantly better on a few cognitive tests than older people from a fishing village.⁵⁸

From all this, it should be obvious that residency in urban versus rural communities is an example of a value-loaded contextual factor which, apart from an often large proportion of older people in the community, reflects e.g. population density, type of work, physical geography, transportation services, access to various other types of services, and social norms.^{59,60} All these aspects of residency may potentially affect functioning and health and therefore urban versus rural residency should

not be overlooked when studying health and health-related states in older populations. In Iceland, more research is needed on older people living in the community outside the capital area, along with a focus on the interplay between environmental factors, disability, and health.

Participation

Participation is one of the positive descriptors of functioning¹ and is an example of ICF's neutral terminology for a construct which resembles what the ICIDH described as a handicap and Nagi as disability. This neutral language has made the ICF concepts appropriate for use in populations irrespective of their level of health or disability. On the other hand, participation restriction is one of the ICF descriptors of disability and denotes the negative aspects of the interaction between an individual (with a health condition) and that individual's environmental and personal contextual factors.¹

Within the area of aging, participation is now recognized as a particularly important health-related outcome as it is related to multiple factors that affect older people's well-being.⁶¹ As mentioned, it replaces the term handicap in the ICIDH¹ and it is conceptually quite similar to Nagi's definition of disability.^{41,42} Recent literature on factors associated with participation in the general population of older community-living people includes variables such as: age, gender, marital status,⁶² basic mobility, balance confidence,⁶³ activity level,⁶⁴ and various environmental facilitators and barriers.^{64,65} Most studies on participation in old age have been carried out in urban communities or without considering the type of community the participants live in. Yet in a recent Canadian study, older people living in metropolitan, urban, and rural areas were shown to have comparable participation levels regardless of differences in environmental context.⁶⁶

Despite widespread promotion of participation as the most important part of functioning, the construction of assessments capturing the construct of participation in the general older population is still in the process of development.^{67,68} One of the main reasons for this delay in participation scale development is most likely that the ICF does not provide clear operational definitions to separate participation from activities.¹ Therefore, ICF users have had to decide on their own terms concerning an operational definition of participation, a state of affairs which unfortunately preserves the conceptual confusion within the literature.

In the context of this thesis we used the basic ICF definition of participation as "a person's involvement in a life situation" and defined activities as "an execution of a task or action by a person".¹ Additionally, to distinguish these components we used the type of environment in which the activity or participation occurs. Activities were operationalized

as the capacity to perform a task in a standard environment (e.g. a clinical, research base in performance measures or assumed environment in self-reports). Participation, however, was operationalized to reflect performance in the older person's real environment and his or her engagement in tasks required to fulfill social roles. Importantly, within the frame of this definition, participation is not restricted to social participation outside the home. It also includes the performance of tasks within the home (e.g. personal self-care), that are parts of social role expectations and inherent in the older person's family and social lives.⁶

Much has been published on the importance of improving the conceptualization of participation within the ICF.^{33,51,69} Autonomy has for example been presented as a fundamental prerequisite for participation^{70,71} and instead of focusing solely on the actual performance of a life task, the potential, the opportunity, and the will to perform a life-task must all be considered.⁶⁹ Therefore, it is preferable to direct the focus in research and practice with older people towards both participation performance (e.g. frequency of participation) and even more importantly to the client-centered perspective of participation (e.g. will, choice, importance, perceived restrictions).^{51,65} More studies are needed of these different aspects of participation within the general population of community-dwelling older people.

Physically active lifestyle

Physical activity has been defined as "any bodily movement produced by skeletal muscles that results in energy expenditure".⁷ According to this definition a person is physically active when living and moving in such a way that energy is spent. Therefore, being physically active is not limited to exercise or leisure-time but includes activities performed in other life domains such as in housework and paid or volunteer work.⁷²⁻⁷⁷ Physical activity is usually rated according to three essential benchmarks: (1) the degree of intensity required within a certain activity period, (2) the duration of the activity period, and (3) how frequently these activity periods occur.⁸

Physical activity is an example of a favorable lifestyle or health behavior which has been described as one of the key factors in preventing disability and poor health in old age by modifying chronic diseases, and through direct effects on various impairments and limitations on activities.^{74,78-82} However, most of the scientific support for these benefits of physical activity is based on leisure-time physical activities such as sport and recreation.⁸⁰

Despite the well-known benefits of an active lifestyle in old age, the prevalence of inactivity appears to increase with aging.^{75,83,84} For example, based on leisure-time physical activity research, sedentary lifestyle appears to be particularly prevalent among older rural people.^{54,56}

Multiple environmental and personal contextual factors have been suggested to explain this inactivity in rural areas.^{59,60} However, as research has shown that older farmers frequently work well past the usual retirement age⁵⁷ there is also a possibility that older people in rural areas fill their physical activity quotient through other life domains than exercise and active recreation.

Not assessing the level of physical activity at work is a very common limitation of physical activity research in old age, reflecting the norm that people at this age should have retired and not participate in physically demanding work. In the time of a potential raise in the retirement age it may become more important than ever to broaden the view from solely leisure-time physical activity to include other domains of habitual living.

Confidence in maintaining balance

Psychological factors related to falls are well-known barriers to older persons' active lifestyle and participation in various life situations.⁸⁵⁻⁸⁷ Between 12% and 65% of older community-dwelling people who had not fallen in the previous year have been found to share a concern about falling.⁸⁸⁻⁹¹ Among those who had experienced a recent fall, the prevalence of fall concerns increased to 29% to 92%,^{91,92} underscoring the magnitude of the problem. Fortunately, an increasing body of evidence indicates that these fall related psychological factors are modifiable,⁹³⁻⁹⁶ e.g. by enhancing an older person's confidence in maintaining balance when moving around.²

The concept of confidence in maintaining balance, or balance confidence, in daily activities has its origin in self efficacy which is a component of Bandura's Social Cognitive Theory.² Within Bandura's theory, self-efficacy refers to the individual's perceptions of his or her capabilities (self-confidence) to mobilize motivation, cognitive resources, and physical capacity to meet given situational demands.⁹⁷ One's self-confidence, whether accurate or not, will either facilitate or hinder an individual's decision to engage in a particular activity. Therefore, balance confidence is one of the fall-related psychological factors which may act as mediating factors between inactivity, physical activity, and participation.⁹⁸⁻¹⁰⁰ It's an aspect of mental function that should be studied further in relation to health, functioning, and contextual factors.

Self-rated health

By exploring definitions of health it becomes clear that there is no gold standard or direct assessment of true health or when a person's health begins to decline. Therefore, the usual way in praxis is to assess various aspects of health to come to a conclusion regarding the general health status of an older person. However, in 1982 Mossey and Shapiro¹⁰¹ presented research results revealing that an older person's perception of

his or her own health was an excellent predictor of seven-year survival. Since then, self-rated health (SRH) has become a widely used indicator of general health and multiple studies have further supported the predictive validity of SRH in older populations. In these studies SRH has been associated with future health, functional decline, and disability.¹⁰²⁻¹⁰⁵

Based on this research and that of others, Jylhä¹⁰⁶ described SRH as an active cognitive process that is not guided by formal, agreed rules or definitions of health. She further portrayed it as an individual and subjective conception that is related to the strongest biological indicator, death; and constitutes a crossroad between the social world and psychological experiences on the one hand, and the biological world on the other. Therefore, in its simplicity, the answer to the SRH question “would you say your health in general is excellent, very good, good, fair, or poor?” appears to summarize the dimensions of health that are most meaningful to each individual.^{107,108}

While the ICF term disability refers to impairment, limitations or restrictions related to a health condition, self-ratings of general health (SRH) refer to the personal value given to these limitations and restrictions.¹⁰⁹ Therefore, although perceptions of health are not included in the ICF framework, multiple variables within various ICF components representing the body and the person in context may play an important role in older persons’ self ratings of health. That is, if a certain activities limitation is highly meaningful to an individual it may lead to poor self-ratings of health. Identifying more factors associated with SRH may create a better understanding of what is important for higher self-ratings of health and direct us towards new ways to influence it.

Challenges in functioning and health assessment

Multiple criteria should be kept in mind when selecting assessments to evaluate aspects of functioning and health in old age.^{110,111} Among the potential challenges researchers and practitioners face in that process are: (1) lack of conceptual clarity regarding disability and health – what do we really want to assess, (2) availability of assessments that evaluate the constructs of interest, (3) quality of the available assessments, and (4) applicability of these assessments for the population and context of interest.

The first challenge, the *lack of conceptual clarity* regarding disability and health, has been introduced in this thesis. Using a conceptual framework such as the ICF, including standardized language, is certainly an important step in dealing with existing confusion regarding what we want to assess.

The second challenge, *availability of assessments* that capture what we intend to evaluate, arises partially from the fact that most assessments currently used in the field of aging are created without referring to a conceptual framework or within another conceptual frame than the ICF. Therefore, to determine if an assessment can be used to evaluate an ICF component, we need to find a way to map that assessment to the ICF conceptual framework. In order to facilitate the use of available assessments within the ICF, so-called linking rules have been established.^{109,112} According to these rules, the first step is to identify the main aim or the meaningful concepts within the assessment of interest. The next step is to link these concepts to the ICF following a few steps that are thoroughly described in the linking rules. The result of applying the linking methodology is a list of ICF categories that is equivalent in content to the original assessment. These ICF categories can then be used to place the assessment within a certain ICF component or domain.

The third challenge, is regarding the *quality of assessments*. Some basic guidelines are available regarding how to assess the psychometric properties of disability assessments¹¹⁰ and the criteria set in such guidelines are dependent on the intended use of the assessment instruments. An example of a factor that relates to the quality of an assessment is the type of underlying scale. Many of the assessments used to evaluate aspects of functioning and health are, for example, based on ordinal scales. Ordinal scales provide ranked scores that give information as to whether values are greater or less with respect to one another, but the intervals between the ordinal scores cannot be assumed to be equal.¹¹³ As equal interval (linear) data are fundamental to all mathematical manipulations, even calculating the mean of summed ordinal scores is inappropriate.^{4,114} Because of these limitations with the ordinal scales commonly used in health sciences, there is a call for them to be transformed into scientific measurements holding to the same standards as in physical sciences.⁴ Scientific measurement has been defined as a quantification of a construct, expressed in equal and additive units (interval or ratio scale) that represent the construct to be evaluated.^{4,5} Rasch analysis is a method that can be used to construct such scales based on equal and additive units.⁴ This means that data can be transformed from an ordinal scale into an abstract, linear, and equal-interval scale. When we analyze our data in such a way, we can evaluate if the transformed data can be successfully converted to a linear measure we can use in mathematical manipulations including parametric statistical tests.

The final challenge I will highlight here is the *applicability of assessments* for the population and context of interest. With the constant growth in international and multicultural research projects, translations and cultural adaptations of assessments are also on the rise. One of the most common translation methods is a translation/back translation.¹¹⁵ In relation to the translation process, as a part of cultural adaptation, test

equivalence between the original and translated version is a very important aim. Eremenco et al.¹¹⁶ identified five types of test equivalence that should be considered: (1) content equivalence, where each item's content is relevant in both the original and target cultures; (2) semantic equivalence, which emphasizes the similarity of meaning of each item in both cultures after translations; (3) technical equivalence, meaning the similarity of data collection methods for the two versions of the assessments; (4) criterion equivalence, meaning that the interpretation of the scores is the same for both versions in their respective cultures; and (5) conceptual equivalence, which means that the assessment evaluates the same theoretical construct in each culture. This process should be followed by field tests of the assessment with people from the target population.

Rationale

The rationale for this thesis is based on two basic premises related to the worldwide aging of populations concerning: (1) trends in disability and poor health in old age and (2) valuable resources in multidisciplinary work, including physical therapy, which may be used to counteract these trends and facilitate health and well-being in old age.

Multidisciplinary efforts, including both preventive and rehabilitative perspectives, should be mobilized to facilitate and optimize functioning and health in old age. For such holistic efforts to be effective, more studies are needed to better understand the biopsychosocial building blocks of functioning and health. However, conceptual confusion has been a serious barrier to research, scientific discussion, and practical implementations in this area. A coordinated implementation of a sound conceptual framework, with internationally agreed-upon language, is needed to advance studies and practice across professional and national boundaries.

Although the phenomena of functioning, disability, and health in old age are a challenge for research and practice, their complexity also opens up multiple possibilities for prevention and intervention. Physical therapists need to study potential ways to contribute to optimal late life functioning and health. This includes, for example, directing the focus towards the building blocks of participation and perceptions of health in old age, which may be among the most ultimate and client-centered outcomes in geriatric practice. Extended information is also needed on a physically active life-style in various life domains and psychological factors that may hinder or facilitate physical activity, participation, and higher self-ratings of health.

An inherent part of all research is selection and application of assessment instruments meant to capture the construct of interest. However, much work is needed to improve the quality of standardized assessments and measures that are contextually relevant in older populations. These

improvements should include an ongoing and improved focus on psychometric properties, standardized assessments, and increased awareness of the merits and usability of modern testing theories. Additionally, translations and cultural adaptations of standardized assessments are of particular concern among non-English speaking nations.

Finally, the increased awareness of the extended importance of the environmental context to the process of aging and health is pushing scientists and practitioners to pay more attention to aging in context. An important part of a person's context is his or her residency. This includes the often under-represented older populations: (1) living in rural areas and (2) in specific cultural and language regions. Iceland contains an example of both, where more representative and population-based research on functioning, health, and aging in an Icelandic context is needed.

Relevance

This thesis was based on research that was designed to be particularly relevant for the discussion on disability, health, and aging in Iceland and with reference to physical therapy research and practice. Importantly, the ICF was applied as an interdisciplinary and international conceptual framework to facilitate understanding, comparability, and explicit discussion of the research results in relation to underlying processes behind participation, a physically active life-style, balance confidence, self-rated health, and the person-environment fit or misfit in old age. Additionally, the use of widely accepted standardized assessments may make the results comparable and relevant in an international context. This thesis should therefore contribute to a growing body of information designed to help address the challenges and opportunities of aging populations.

Aging populations in the coming decades call for focused efforts directed towards improving functioning of older people, which may enable them to live not only long but also healthy and fulfilled lives. The phenomena of functioning and health are by nature complex and preferably built on interdisciplinary approach. Therefore, the content of this thesis should be relevant for all those interested in health and disability in aging independently of their professional background. However, the rationale for my research can be traced to my physical therapy background and my wish to further encourage physical therapists to find systematic ways to maintain a holistic and client-centered view of late-life functioning, health, and well-being. Thus, the content of this thesis will hopefully make some contributions to further professional growth beyond the level of body structures and functions, to a level where physical therapists consistently incorporate meaningful aspects of activities, participation, and contextual factors into their research and practice with older clients.

AIMS OF THE THESIS

General aim

The general aim of this doctoral thesis was to investigate older Icelanders' level of physical activity, participation in life-situations, and their perceptions of their own health. This included an exploration of potential influences of urban versus rural residency, an evaluation of the measurement properties of a balance confidence scale and examination of the proposed usefulness of the International Classification of Functioning Disability and Health (ICF) as a conceptual framework to facilitate analysis and understanding of selected outcomes.

Specific aims

To analyze the physical activity behavior among older rural and urban community-dwelling Icelanders based on a broad conceptual view of physical activity (Paper I), and to study the association of physical activity with aspects of participation (Paper III) and self-rated health (Paper IV).

To investigate, by using Rasch analysis, the psychometric properties of the Activities-Specific Balance Confidence (ABC) Scale when applied in a new Icelandic context and to transform the ordinal ABC Scale to an interval scale (Paper II) for examination of its association with aspects of participation (Paper III) and self-rated health (Paper IV).

To identify variables from different components of the International Classification of Functioning, Disability and Health (ICF) associated with older people's participation frequency and perceived participation restrictions (Paper III), and to study the relationship of participation to self-rated health (Paper IV).

To study the association between self-rated health and ICF components through standardized scales and nonstandardized sociodemographic questions commonly used in geriatric physical therapy practice and research (Paper IV).

To determine how the environmental factor, urban versus rural residence, relates to the pattern of physical activity (Paper I), aspects of participation (Paper III), and self-rated health (Paper IV).

METHODS

Study design and context

The study design was cross-sectional and data were collected in June through September 2004 in one urban and two adjacent rural municipalities in Northern Iceland (Figure 5). The study areas were selected as they fulfilled the following criteria: (1) represented a part of Iceland with understudied older populations, (2) fulfilled the pre-determined definitions of urban and rural areas,^{10,11} and (3) were closest in distance from the main research base.

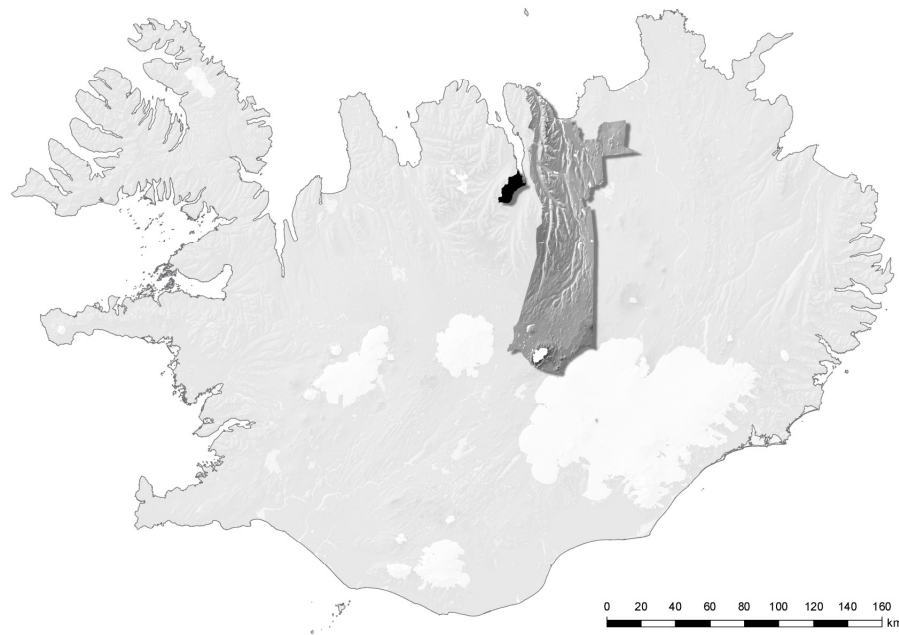


Figure 5. Iceland and the urban (black) and rural (dark gray) study areas. Source: Prepared to this study by the National Land Survey of Iceland.

The urban study area was a university town and the second largest urban municipality in Iceland after the Greater Reykjavík capital area. It had approximately 16,500 inhabitants and of these 12% had reached 65 years of age. Of this older age group, about 88% were registered as community-dwelling, and of these approximately 44% were men. In this urban area there was no more than 200 meters between houses, and inhabitants earned their living from sources other than farming.

The rural area is separated geographically from the urban study area by a fjord and a mountain range. In total, it had approximately 1000 inhabitants, 18% of them had reached 65 years of age, and of these 56% were men. As there was no institution for older people in the municipality, everybody was registered as community-dwelling. The inhabitants lived on farms or in other isolated houses and the majority earned their living by farming.

Participant selection

The inclusion criteria for participation were as follows: (1) had to be at least 65 years of age, (2) had to be community-dwelling, and (3) had to be able to communicate verbally on a telephone and set up a meeting time with a research assistant.

We used the Icelandic national register and the first two inclusion criteria to create a list of the total population of older residents in the urban and rural study areas. In Iceland, older people often keep their old home addresses although they move into an institution. Therefore, we sent our national register list to institutions for older people within the urban municipality and to the institutions closest to the rural municipalities. The directors of the institutions assisted us by removing their residents from the list. Thereafter, a random sample of 251 people born before 1940 was drawn from these populations using Statistical Package for the Social Sciences (SPSS) version 11.5 for Windows (SPSS Inc, Chicago, IL). The information in the national register was from February 2004 but the sample was drawn in May of the same year.

The randomly selected sample consisted of 160 persons living in urban and 91 in rural areas (Figure 6). The rural group was oversampled in order to ensure enough observations to produce reliable estimates for that part of the total sample and to optimize power based on affordable sample size and thereby decrease the risk of Type II errors.¹¹⁷

An introductory letter was mailed to the intended randomly selected sample (Figure 6). The letter was followed up by a telephone call which included basic screening for eligibility based on the second and third inclusion criteria. If the older individual met all inclusion criteria, and was willing to participate, a time to meet was established. Those who declined to participate were asked to state the reason.

A total of 15 persons were excluded from participation because they didn't fulfill the inclusion criteria. Of these, seven persons had recently moved into an institution, five could not communicate verbally according to a caregiver, two were inaccessible, and one had passed away.

Of the remaining 236 persons who fulfilled the inclusion criteria, 186 agreed to participate. Therefore, the participation rate was 78% in the

urban and 80% in the rural area. The urban sample consisted of 118 participants. Their ages ranged from 65 to 88 years (mean = 74, SD = 6.3), and 62/118 (53%) were females. The rural sample consisted of 68 participants. Their age ranged from 65 to 86 years (mean = 74; SD = 6.2) and 27/68 (40%) were females.

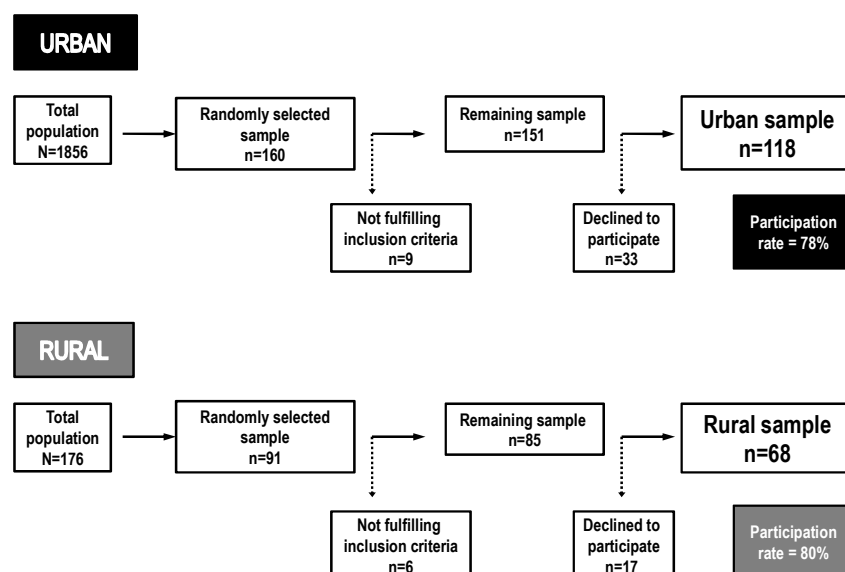


Figure 6. Selection of the population-based study sample. Source: A modified figure from Paper I.

The 50 people who declined to participate did not differ significantly from the study sample with regard to age, sex, or residence. In the urban area, 33 declined; their age ranged from 65 to 86 (mean = 72, SD = 5.8) and 19/33 (57.6%) were females. In the rural areas 17 declined; their age ranged from 65 to 91 years (mean = 74; SD = 6.8) and 5/17 (29.4%) were females. The reasons for not participating included not having time, being opposed to research, being too young and healthy, and being too old and sick.

Ethics

The Icelandic National Bioethics Committee reviewed and approved the study before its initiation (no. 04-037-S1) and The Icelandic Data Protection Authorities were also informed about the study (no. S1948/2004). All participants signed a written informed consent to participation in the study prior to data collection.

Procedure

Selection of variables and ICF linking

The variables in the thesis were selected to represent a broad perspective of functioning and health, as defined by the ICF. The selection of representative assessments was based on former studies and practice within the area of aging and physical therapy, and theorized importance for functioning and health in old age. All variables, except self-rated health, were systematically linked to the most appropriate ICF components using the ICF linking rules.^{109,112} Following these rules, we went through a process of identifying the meaningful concepts for each item and the overall aim of the standardized assessment, and determining the aim of the nonstandardized questions. These concepts and aims were then linked to the most appropriate ICF components (Figure 7). Self-rated health, however, was conceptualized as a background experience with a potential to interact with all the ICF components.

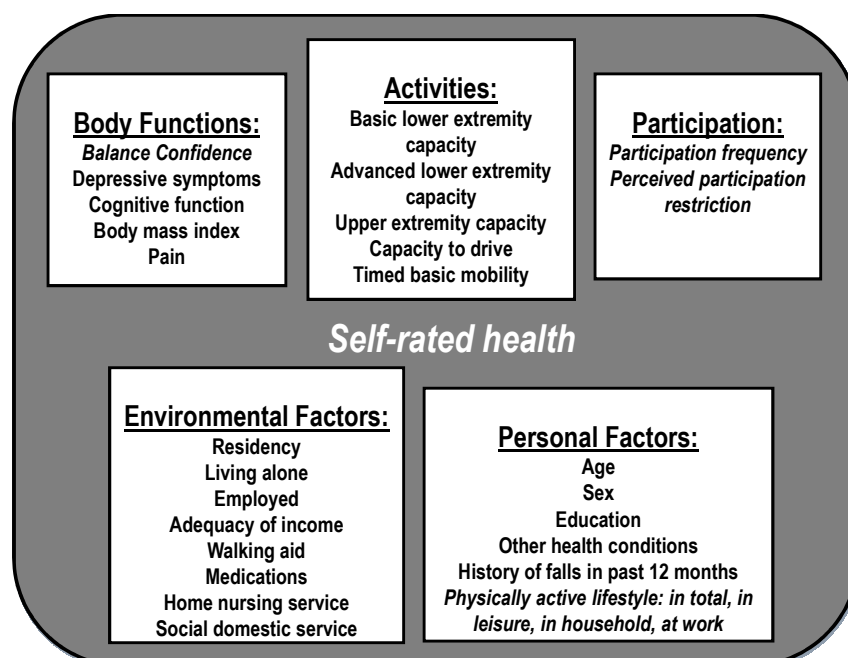


Figure 7. Variables in our study linked to ICF components and self-rated health conceptualized as a background with the potential to interact with all the ICF components. The main outcomes in the thesis are presented in italic font.

Translations of standardized assessments

Apart from using standardized assessments in this study, the goal was also to obtain data that could be used in international comparisons of older people's functioning and health. To fulfill these criteria we searched for internationally accepted standardized assessments to capture our main constructs of interest. The assessments should have sufficiently established psychometric properties and be applicable in our population of older community-dwelling urban and rural Icelanders. Translation and standardization of a few selected assessments was necessary prior to data collection, as they were not available in Icelandic. These standardized assessments were the Physical Activity Scale for the Elderly (PASE),¹¹⁸ the Activities-specific Balance Confidence scale (ABC),¹¹⁹ and the Late-Life: Function and Disability Instrument (LLFDI).¹²⁰

A translation/back-translation method^{115,121} was used to produce Icelandic versions of the assessments and their instructions for administration. Cultural adaptation¹¹⁶ was included in the translation process to optimize the test equivalence between the original and translated version.

Two bilingual professionals independently translated each assessment from English to Icelandic. They were instructed to aim for conceptual equivalence between the original and the translated versions. Inconsistencies in these translations were resolved by discussion among the translators. A specialist in Icelandic language then reviewed the draft and made some recommendations related to language usage. A third bilingual professional, who had no knowledge of the original assessments, translated the Icelandic draft back into English. Two of the translators, in cooperation with the assessments' developers, compared the original and back-translated versions and negotiated a final Icelandic version of each assessment. The assessments were pilot-tested on three urban and two rural community-dwelling volunteers to evaluate the relevance and ease of comprehension of the items.

Data collection

Three research assistants were trained in administration of the assessment battery. To minimize effects of interviewer bias, all research assistants were unaware of the research hypotheses and followed standardized instructions when interviewing and testing participants. The initial telephone interview included booking of a time to meet either at the participant's house or at a research base within the participant's municipality. Everybody in the rural sample and the majority of the urban chose a home visit during which the assessment battery was administered.

The assessment battery was administered in a face-to-face interview format and based on self-report, with the exceptions of one performance test of basic mobility and a test of cognitive function. All standardized assessments were administered according to established protocols. This

face-to-face mode of administration was selected to optimize the participation rate and accuracy of responses among individuals with hearing, vision, or any minor communicative problems. The participants were shown, in an enlarged font, the response options for each question.

Assessments

Table 1 presents basic information on all the variables used in the thesis (Papers I–IV). These variables are based on standardized assessments and nonstandardized sociodemographic questions. The standardized assessments have specific protocols for administration and implementation, they are scored on an ordinal, an interval, or a ratio scale, and they have been evaluated for psychometric properties. The sociodemographic questions were scored on a nominal or ordinal scale. The main outcomes in the thesis, physical activity, balance confidence, participation, and self-rated health were all assessed by standardized means and are described further in the following text.

Physical Activity Scale for the Elderly (PASE)

The PASE¹¹⁸ was used as an indicator of a physically active lifestyle which we linked to the ICF personal factors component. The PASE is a brief questionnaire which provides a self-report on physical activities during the preceding week.^{118,122} It was designed for use in epidemiological studies and the original study sample during the test development was a general population of non-institutionalized American people over the age of 65.^{118,122} The PASE is built to capture the type of physical activities and life domain in which they occur, and the three basic elements that operationalize the concept of physical activity: (1) frequency, (3) duration, and (4) intensity.^{8,75}

PASE consists of 12 questions that examine various types of physical activity in three life domains¹¹⁸ that form the basis for subscales of the PASE which we used in this thesis. The leisure-time domain (PASE-leisure) includes walking outside the home, and light, moderate, and strenuous sport or recreation such as dancing, swimming, biking, or hiking. The household domain (PASE-home) covers light and heavy housework, home repairs, lawn work, gardening, and caring for another person. The work-related domain (PASE-work) focuses on work for pay or as volunteer.

The three domains of PASE have different rating scales.¹²² Firstly, the time spent in leisure activities is recorded as never, seldom (1–2 days/week), sometimes (3–4 days/week), and often (5–7 days/week). The duration of each activity is then categorized as less than 1 hour, 1 to 2 hours, 2 to 4 hrs and more than 4 hours per week. Secondly, work-related physical activity is measured directly in hours per week. Thirdly,

household activities are measured on a dichotomized scale that examined whether or not an activity was performed during the preceding week.

The PASE score is calculated by multiplying the amount of time spent in each activity by given item weights and then summing the activities. The item weights used in the scoring algorithm represent the intensity of each activity and were originally based on comparing the PASE outcome with physical activity estimated with a three day motion sensor counts, a three day physical activity diary, estimates of daily energy expenditures, and a global activity self-assessment. The duration and frequency parts of the PASE could potentially be an interval scale (min per day). They are, however, reduced to an ordinal scale in PASE-leisure and PASE-home to decrease the respondents' and administrative burden. Physical activity scores can be calculated for each of the PASE subscales or summed up for a total PASE score of potential values from zero to 400. People who are extremely physically active can score higher than 400. Although the PASE was originally not designed to be partitioned in subscales, it has been used as such to provide informative results on physical activity in different life domains.¹³¹

Previous evaluation of intra-rater reliability of the PASE in older rural people resulted in an intraclass correlation coefficient (ICC) of .91 for the total PASE score, .56 for the leisure subscale, .94 for the home subscale, and 0.91 for the work subscale.¹³² Internal consistency has been reported as Cronbach's alpha of .71.¹³³ Construct validity was evaluated in the original study sample where PASE scores correlated significantly with indicators for balance, strength, self-assessed health status, and Sickness Impact Profile scores.¹¹⁸ Results are available from a study on an adjusted Dutch version of the PASE using a doubly labeled water method as a criterion for the PASE score validity. This version of the PASE was presented as a valid tool for classifying healthy older men and women into different levels of physical activity.¹³⁴

Activities-specific Balance Confidence (ABC) scale

In our study, we used ABC to assess balance confidence and linked it to the ICFs body functions component. ABC is a 16 item standardized questionnaire in which respondents are asked to rate their level of confidence in maintaining balance and remaining steady while performing specific activities in and outside the home.^{2,119} ABC was based on the Falls Efficacy Scale, and with the goal of including: (1) more challenging activities, making it more suitable for highly functioning seniors and (2) items describing specific everyday activities.² The original study sample during the assessment development consisted of 60 Canadian participants that were sampled purposefully to represent people of high and low mobility levels. They were all community-dwelling and over the age of 65.

Table 1. Description of the variables in the thesis (O = outcome variable, √ = explanatory and descriptive variables, – = variable not included)

ICF	Variable	Standardized assessment or question; scale; further information	Papers			
			I	II	III	IV
Personal factors	Age	Age; interval scale (years); obtained from the national registry and confirmed by self-report.	√	√	√	√
	Age group	Age group; ordinal scale; younger = 65–74 years old, older = 75–88 years old.	√	–	–	–
	Sex	Sex; nominal scale (0–1); 0 = woman, 1 = man.	√	√	√	√
	Education	Education; ordinal scale (years); higher score = more self-reported years of formal education.	√	–	√	–
	Other health conditions	Medical diagnoses; ratio scale (count); higher score = more self-reported medical diagnoses.	√	√	√	√
	History of falls	Self-reported falls in past year; ordinal scale (0–1); 0 = no fall, 1 = at least one fall.	–	√	–	–
	History of recurrent falls	Self-reported recurrent falls in past year; ordinal scale (0–1); 0 = no or one fall, 1 = at least two falls.	–	√	√	–
	Total physical activity	The Physical Activity Scale for the Elderly (PASE)*; ordinal scale (0–400+); higher score = more energy spent in self-reported physical activity in leisure-time, household, and work.	O	–	√	–
	Leisure-time physical activity	PASE-leisure*; ordinal scale (0–400+); higher score = more energy spent in self-reported leisure-time activities e.g. walk, exercise, sport, or active recreation.	O	–	–	√
	Household physical activity	PASE-home*; ordinal scale (0–171); higher score = more energy spent in self-reported light and heavy housework, home repairs, lawn work, gardening, or caring for another person.	O	–	–	√
	Work-related physical activity	PASE-work*; ordinal scale (0–400+); higher score = more energy spent in self-reported work for pay or as a volunteer.	O	–	–	√
Environmental factors	Residency	Residency; nominal scale (0–1); 0 = rural, 1 = urban; obtained from national registry.	√	√	√	√
	Living alone	Living alone; ordinal scale (0–1); 0 = yes, 1 = no.	√	–	√	–
	Employed	Employment status; ordinal scale (0–1); 0 = no, 1 = yes.	√	–	√	–
	Adequacy of income	Adequacy of income; ordinal scale (0–1); higher score = income perceived as adequate to fulfill daily needs.	–	–	√	√
	Walking aid	Walking aids; ordinal scale (0–1); higher scores = self-reported use of a walking aid in daily life outdoor or indoor.	√	√	–	–
	Medications	Medications; ratio scale (count); higher score = more prescribed medications; information from a medication list.	√	–	–	–
	Home nursing service	Home nursing service; ordinal scale (0–1); higher score = self-report of receiving home nursing service from the municipality.	√	√	–	–
	Social domestic service	Social domestic service; ordinal scale (0–1); higher score = self-report of receiving social domestic service from the municipality.	√	√	–	–

*PASE = The Physical Activity Scale for the Elderly is a self-report of physically active lifestyle in the past week.^{118,122} The total PASE score can be divided into three parts: PASE-leisure, PASE-home, and PASE-work. PASE scores are indicative of energy spent within each of these three habitual life domains. Usually the total scores range from 0–400. Extremely active individuals can achieve even higher scores.

Table 1. Continued

ICF	Variable	Instrument or question; scale	Papers			
			I	II	III	IV
Body functions	Balance confidence	Activities-specific Balance Confidence scale (ABC); ¹¹⁹ ordinal scale (0–100); higher score = more self-reported balance confidence in 16 daily activities of greater or lesser challenge during position changes or walking.	–	0	✓	✓
	Depressive symptoms	Geriatric Depression Scale; ¹²³ ordinal scale (0–30); higher score = more depressive symptoms. A score of more than 10 indicates that a depression may be present. ¹²⁴	✓	✓	✓	✓
	Cognitive function	Mini-Mental State Examination; ¹²⁵ ordinal scale (0–30); higher score = better cognitive function. A score of less than 24 indicates that a cognitive impairment may be present. ¹²⁶	✓	✓	✓	✓
	Weight maintenance	Body Mass Index (BMI); interval scale (kg/m ²); calculated from self-report on height and weight.	–	✓	✓	–
	Pain	Bodily Pain subscale of SF-36†; interval scale (0–100); higher score = less pain.	–	–	✓	✓
Activities	Basic lower extremity capacity	LLFDI: Basic Lower Extremity Functioning‡; interval scale (0–100); higher score = more self-reported capacity in 14 activities that involve standing, stooping, and fundamental walking.	–	–	–	✓
	Advanced lower extremity capacity	LLFDI: Advanced Lower Extremity Functioning‡; interval scale (0–100); higher score = more self-reported capacity in 11 activities that involve a high level of physical ability and endurance.	–	–	✓	✓
	Upper extremity capacity	LLFDI: Upper Extremity Functioning‡; interval scale (0–100); higher score = more self-reported capacity in seven activities that involve hands and arms.	–	–	✓	✓
	Capacity to drive	Capacity to drive a car; ordinal scale (0–1); higher score = self-reported capacity to drive a car.	–	–	✓	–
	Timed basic mobility	Timed Up & Go test; ¹²⁸ ratio scale (time in sec); higher score = worse mobility based on slower timed performance in: stand up from a chair, walk 3 meters, turn, walk back to the chair, and sit down. A score of more than 10 sec indicates that mobility limitation may be present.	✓	✓	✓	✓
Participation	Participation frequency	LLFDI: Frequency Dimension‡; interval scale (0–100); higher score = more self-reported frequency of participation in 16 life situations.	–	–	0	✓
	Participation restriction	LLFDI: Limitation Dimension‡; interval scale (0–100); higher score = less perceived restrictions for participating in 16 life situations.	–	–	0	✓
	Self-rated health	Single item standardized question; ordinal scale (1–5); higher score = worse perceived health.	–	–	–	0

†SF-36 = The SF-36® Health Survey is a generic measure of health status which has summary scales on physical and mental health.¹²⁷ The physical health summary integrates outcomes from scales for physical functioning, physical role, bodily pain, and general health.

‡LLFDI = The Late-life: Function and Disability Instrument is based on the Nagi's disability framework,¹²⁰ yet it has been used with promising results to measure ICF's participation and activities. The LLFDI function domain¹²⁹ contains 3 subscales that can measure activities in upper and lower extremities and the LLFDI disability domain¹³⁰ includes 2 subscales that may be used to measure participation.

The 16 ABC items reflect activities of greater or lesser challenge for balance and are performed during position changes, standing, or walking. When developing the ABC, scalogram analysis was used to establish the hierarchical order of the items,² which revealed that the easiest item was “reach at eye level,” and the most difficult item was “walk on icy sidewalks.” For each item, participants are asked the question: “How confident are you that you can maintain your balance and remain steady when you...”¹¹⁹ The participants then self-rate their balance confidence on an 11 point ordinal scale (with 10 percentage point increments), ranging from zero (no confidence) to 100% (completely confident). The responses on the assessment items are summed and divided by 16 to provide an overall mean balance confidence score which can range from zero to 100. A higher score indicates more balance confidence.

Previous research has shown high internal consistency (Cronbach alpha = .96) and test-retest reliability ($r = .92$) of the ABC.² Its concurrent validity was supported with a significant correlation between lower ABC scores and both lower levels of mobility² and more frequent falls.¹³⁵ ABC scores have also been shown to discriminate between fearful and non-fearful older people, between those who avoided activity due to fear of falling and those who did not avoid activity,¹³⁶ and between groups of older people physically functioning at different levels.¹³⁷ In a cross-sectional study on older community-dwelling people, an ABC cut-off score of 70% resulted in 84% sensitivity and 87% specificity in correctly classifying people with and without a history of falls.¹³⁵ Some evidence of reliability and validity of the ABC scores when used with groups with specific medical conditions, such as vestibular disfunction,¹³⁸ lower-limb amputations,¹³⁹ stroke,^{140,141} and Parkinson’s disease¹⁴² also exist. This evidence for validity and reliability of the original ABC scale is based on classical test theory. Modern test theory methods have only been used to study the properties of a simplified version of the ABC with a four-category rating scale and the “walk on icy sidewalks” item removed.¹⁴³

Late-Life: Function and Disability Instrument (LLFDI)

To assess self-reported frequency of participation and perceived participation restriction in life situations, we chose the disability part of LLFDI (LLFDI-D).¹³⁰ LLFDI is a measure which was designed to assess two distinct outcomes of function and disability in epidemiological research among community-dwelling older adults.^{129,130} The assessment developers used a convenience sample of 150 non-institutionalized U.S. adults aged 60 to 98 years (mean = 76, SD = 8.5), predominantly white well-educated females, and 20% from rural areas. LLFDI’s conceptual base is Nagi’s disablement model; the authors defined functional limitations as limitations in a person’s ability to do discrete actions and disability as a person’s performance of socially defined life tasks expected of an individual within a typical socio-cultural and physical

environment.¹²⁰ Despite the differences in Nagi's and the ICF frameworks, LLFDI has been used with promising results to distinguish ICF's participation from activities.¹⁴⁴ The disability part of LLFDI does also have the ability to capture both frequency of participation and perceived restrictions to participation.⁶⁵

The 16 items LLFDI-D focus on how an individual performs in his or her usual environment to fulfill social roles (10 items) along with personal care (6 items). The assessment items spread across a broad range of life-situations which should minimize any floor or ceiling effects of the instrument.¹⁴⁵ There are two sets of questions to each of the items, addressing frequency and perceived restriction. Participation frequency describes the individual's regularity of participating in life tasks.¹³⁰ Participation frequency questions are phrased, "How often do you do...?" with five response options from "very often" to "never". Participation restriction describes perceived restrictions to perform these life tasks and include both personal (health, physical, or mental energy) and environmental (transportation, accessibility, or socioeconomic) factors. The participation restriction questions are phrased "To what extent do you feel limited in doing ...?" with five response options from "not at all" to "completely".

The answer to each question on the LLFDI-D is scored in a 5 category ordinal scale. Item scores for each participation dimension are then added up to form a raw summary score that can range from 16 to 80. By using a conversion tables, created through Rasch analyses, these raw scores are then transformed to a measure on an interval scale which has been scaled to range from zero to 100.¹²⁰ Higher scores reflect more frequent participation or less perceived restriction.

The LLFDI-D has shown acceptable reliability and validity among community-dwelling older adults. Fifteen participants from the original study sample repeated the LLFDI-D within 1 to 3 weeks. The test-retest reliability was ICC = .68 for participation frequency and ICC = .82 for participation restriction.¹³⁰ LLFDI-D validity has been supported in studies associating its scores with the Physical Functioning scale of the Short Form 36-item Health Survey (SF-36)¹²⁰ and the London Handicap Scale.¹⁴⁶ However, two performance tests, the Short Physical Performance Battery and self-paced 400 m walk, only had a weak correlation with participation restriction and a non-significant correlation with participation frequency.¹⁴⁷

Self-rated health (SRH)

To assess perceptions of own health among our participants we selected a standardized single item question on global health status "Would you say your health in general is excellent, very good, good, fair, or poor?".¹⁴⁸ Quite a few versions of this question exist. However, the one we selected

was included as the first question in the well-known SF-36¹⁴⁹ and has been used to predict functional decline and mortality in older adults.¹⁰³

Studies on psychometric properties of SRH in older populations do mostly focus on validation. While predictive validity has been shown within many cultures and language regions,^{106,108} research on the reliability of SRH in older populations has been sparse. Therefore, we assessed the test-retest reliability of the SRH question by asking a subgroup of urban participants to repeat the assessments within seven days after the original testing date. The first 20 participants who agreed to repeat the assessments participated in a small reliability study. This subsample consisted of 10 women and 10 men, the age ranged from 69 to 86 years, and the mean age was 76 years (SD = 5.6). The weighted kappa coefficient was .48 (95% CI = .25–.71) and the ICC[2,1]^{150,151} was .63 (95% CI = .289–.835). Both coefficients indicate moderate test-retest reliability¹¹⁰. Our results were comparable to an ICC = .69 for the same single-item SRH question in a sample with mean age of 58 years (SD = 15) and of mostly black (61%), males (71%).¹⁵²

Data analyses

Table 2 presents a summary of the main statistical methods used to analyze data in this thesis.

Table 2. The main statistical methods in the thesis (√ = applied; – = not applied)

Statistical method	Paper			
	I	II	III	IV
Three-way Analysis of Covariance (ANCOVA)	√	–	–	–
Binary logistic regression (univariate and multivariate)	√	–	√	–
Ordinal logistic regression (univariate and multivariate)	–	–	–	√
Linear regression (univariate and multivariate)	–	–	√	–
Rasch analysis	–	√	–	–
Power analysis	√	–	–	–
Calculation of Intraclass Correlation Coefficient (ICC)	–	–	–	√
Calculation of weighted Kappa coefficient	–	–	–	√

The statistical analyses were performed with: (1) Statistical Package for the Social Sciences, versions 12.0 to 17.0 and complex samples version 14.0 (SPSS Inc, Chicago, IL) (Paper I–IV), (2) STATA 10.1 (StataCorp, College Station, TX) (Paper III, IV), (3) Winsteps computer software (Winsteps Inc, Chicago, IL) (Paper II) (4) KAPPA.EXE version 4.0 (JH Abramson & PM Gahlinger) (Paper IV), and (5) G*Power version 3.0 (Institute for experimental psychology, Heinrich-Heine-University, Dusseldorf, Germany) (Paper I). No corrections were made for multiple statistical tests¹⁵³ and significance was set at $p \leq .05$.

Descriptive statistics for participants' characteristics were summarized by use of means, standard deviations, and ranges for continuous data and frequency distributions and proportions for categorical data. These characteristics were also described by urban and rural study groups and compared by *t* test for continuous data; the Mann-Whitney U test was used for ordinal data and Pearson's Chi-square test for binary data.

Missing data

In general, missing data on study variables ranged from zero to three. Six participants, however, had missing values on the TUG based on their inability to walk or lack of space in their home. These missing values were not replaced. On LLFDI, missing values were more frequent than in other assessments (Table 3).

Table 3. Frequency of missing items on the Late-Life: Function and Disability Instrument (\checkmark = missing values replaced, – = missing values not replaced)

LLFDI measures	Participants N	Missing items N	Missing item(s) replaced
Upper and lower extremity capacity (32 items)	6	1	\checkmark
	2	2	\checkmark
	1	32	–
Participation frequency (16 items)	18	1	\checkmark
	1	2	\checkmark
	2	16	–
Participation restriction (16 items)	28	1	\checkmark
	14	2	\checkmark
	6	3	\checkmark
	5	4	\checkmark
	1	5	\checkmark
	2	16	–

Five percent of the participants missed at least one of the 32 items in the upper and lower extremity capacity measures, 11% of participants had a missing value on the participation frequency measure, and 30% on the perceived participation restriction measure. When participants expressed they did not know, or did not want to answer a question on LLFDI, the only option was to leave the item missing and the LLFDI scoring algorithm does not allow a total score to be calculated if there is any missing item. Based on the severe effects of these missing items on the total score, we applied the same replacement criteria as previously done with SF-36.¹¹¹ If one half or fewer of the items in each subscale were missing, a person-specific estimate (mean of the non-missing items) was replaced. Otherwise, the scale was assigned a missing value.

Three participants with visual impairments were not able to complete the MMSE. Therefore their MMSE was scored according to MMSE-blind¹⁵⁴ where eight items requiring image processing are omitted. The MMSE-

blind scores were then linearly transformed to the same scale as the MMSE by multiplication by a constant (30/22).¹⁵⁵

Weighting the data

Prior to inferential statistical analysis, sample design weights¹⁵⁶ were applied to all data to adjust for the uneven proportion of urban (8.6%) and rural (51.7%) representatives in the study. The weight for the urban sample was 15.7 (1856/118) and 2.6 (176/68) for the rural sample.

Physical activity (Paper I)

The main outcomes in this part were the total physical activity (PASE) and its three building-blocks: PASE-leisure, PASE-home, and PASE-work. Logarithmic transformation was performed on the PASE (PASE_{log}) and PASE-leisure scores (PASE-leisure_{log}) to correct for a positively skewed data set and to fulfill the criteria for analysis of covariance (ANCOVA). The PASE-home scores did not require any transformation. The departure from normality was too severe for the PASE-work variable to be appropriate for ANCOVA so it was dichotomized into “any physical work” versus “no physical work” for use in a binary logistic regression analysis.

Three-way ANCOVA was used for the PASE_{log}, PASE-leisure_{log}, and PASE-home to compare the outcomes by residency (urban and rural), gender, and age group (65–74 and 75–88 years old). The continuous variables derived from TUG, GDS, and years of education were included as covariates in the ANCOVA.

The ANCOVA results were presented as adjusted means (mean_{adj}) which were anti-logged in the case of the PASE_{log} and PASE-leisure_{log} for ease of interpretation, and *p* values. The dichotomized PASE-work results were used as an outcome in a binary logistic regression analysis, exploring the association with the same explanatory variables and covariates as in the ANCOVA. The results were presented as adjusted odds ratios (OR_{adj}) along with 95% confidence intervals (95% CI).

In post hoc power analyses, medium effect sizes were selected based on Cohen’s effect size conventions. For the *t* test on differences between urban and rural groups in total physical activity scores, at $\alpha = .05$, effect size = .5, and sample sizes of $n_1 = 113$ and $n_2 = 66$, our analysis yielded a power of .89 ($t_{177} = 1.97$, $\delta = 3.23$). For the ANCOVA with PASE_{log} as the dependent variable, at $\alpha = .05$, effect size = .25, and sample size of 179, our analysis had a power of .91 ($F_{1,167} = 3.9$; $\lambda = 11.19$).

Balance confidence (Paper II)

Rasch analysis was used to test the psychometric properties of the ABC and to transform the ABC scale to an interval measure prior to further

statistical analysis. A detailed description of Rasch analysis methods has been provided elsewhere.⁴ In brief, we first evaluated the psychometric properties of the 11-category rating scale by using Linacre's criteria¹⁵⁷ to determine if: (1) each category contained at least 10 observations, (2) distribution of category ratings was reasonably uniform, (3) average category measures advanced progressively with higher ratings, (4) rating scale outfit *MnSq* goodness-of-fit statistics (fit statistics) were less than 2.0, and (5) rating scale threshold calibrations advanced monotonically. The second step was to evaluate if the ABC items defined a unidimensional construct by examining fit statistics for each item. Both outfit and infit *MnSq* and standardized (*z*) fit statistics were considered.¹⁵⁸ Because a rule of thumb for reasonable fit statistics is 0.6 to 1.4 for rating scales,¹⁵⁹ we set our criteria for item removal based on outfit or infit *MnSq* greater than 1.4 accompanied by *z* greater than or equal to 2. The third step was to examine Rasch indices of reliability^{160,161} to explore if items reliably separated participants into statistically distinct strata of balance confidence. Our final step was to examine the ABC item difficulty and person confidence hierarchies. At all these steps our plan was to modify the ABC where indicated to improve its psychometric properties.

Participation (Paper III)

We used regression analyses to identify variables from different components of ICF which were associated with participation frequency and perceived participation restriction. Participation frequency was analyzed with linear regression, but as the participation measurements were extremely negatively skewed we had to dichotomize the continuous scale and analyze the outcome with binary logistic regression. As no valid cut-off scores were available for the LLFDI measures, participation restriction was dichotomized on the weighted median score of 83. The new dichotomized participation restriction variable had an ordinal scale with scores of zero = more restriction (score of 0–82) and 1 = less restriction (score of 83–100).

To meet normality assumptions in the regression analyses we used log-transformed PASE total scores and our modified interval scale version of the ABC (Paper II). The explanatory variables represented aspects of activities, body functions, environmental factors, and personal factors components of the ICF framework.

We used univariate analyses followed by: (1) eight separate multivariate analyses where we developed explanatory ICF components models for participation frequency and participation restriction, based on variables from each of the ICF components, and (2) two multivariate analyses where we developed minimal multivariate models, one for each aspect of participation, based on variables from all ICF components. Starting with a model including all variables, we used backward selection procedure to remove variables with the highest *p* values, one by one, until we reached a

minimal model where all variables had $p \leq .10$. Age and gender were retained in the minimal models to adjust for their potentially modifying effect on other variables. To assist us in interpreting model fit at each step we calculated R^2 and McFadden's pseudo R^2 values.¹⁶² Therefore the results were presented as: β , β_{adj} and R^2 (linear regression); OR, OR_{adj} and McFadden's pseudo R^2 (logistic regression); and p values.

Self-rated health (Paper IV)

We used ordinal logistic regression¹⁶³ to examine how variables from different ICF components were associated with the five categories of SRH. This type of logistic regression is based on an assumption of proportional odds. That is, we assumed that the likelihood or the odds (the effect of the explanatory variables) are the same when moving between any of the five categories on the SRH scale.

Prior to the analysis, the original test scores on SRH were re-coded so that higher scores indicated better health (1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent). To meet normality assumptions in the regression analyses, we log-transformed PASE-leisure, dichotomized PASE-work (zero = no work-related physical activity, 1 = some work-related physical activity), dichotomized the perceived participation restriction on the weighted median score of 83 (zero = more restriction, 1 = less restriction), and used our modified interval scale version of the ABC (Paper II).

In univariate ordinal regression analyses, we calculated unadjusted proportional odds ratios (OR) to determine the relationship between SRH and each of the explanatory variables. Then we used a full multivariate ordinal logistic regression model to provide adjusted proportional OR (OR_{adj}) to determine the independent relationship between SRH and each of the explanatory variables. Finally, we established a minimal multivariate ordinal regression model which included only variables that were significantly related to SRH. This was done by removing insignificant variables from the full multivariate model, one by one, starting with the variables with the highest p value. The results were presented as OR, OR_{adj} , 95% CI, and p values. To assist us in interpreting model fit at each step we calculated McFadden's pseudo R^2 values.

RESULTS

Participants

Table 4 presents the characteristics of the 186 participants and their contextual factors. Participants' ages ranged from 65 to 88 years and as one third of the sample was drawn from rural communities the proportion of men was unusually high for this age group (52%). All participants were white and spoke fluent Icelandic even though five of them had been born and raised in other European countries. Five percent reported no medical diagnosis, 30% reported one or two diagnoses, and 65% reported three or more diagnoses. The MMSE scores ranged from 16 to 30, and 20 (11%) of the participants received MMSE scores lower than 24. Years in school ranged from zero to 20 with an average of 7.5 years.

Compared to the older adults in the urban area, the people in the rural areas were more likely to: (1) have less education, (2) have more health conditions, (3) be less physically active in leisure-time but more physically active in work, (4) not to live alone, (5) perceive their income as inadequate, (6) have more depressive symptoms, (7) have more pain, (8) have limited upper extremity capacity, (9) perform worse in timed basic mobility, (10) participate less frequently, (11) perceive more participation restrictions, and (12) have worse self-rated health.

Physical activity pattern (Paper I)

The average total PASE score was 130 and it varied greatly between individuals, ranging from zero to an extreme value of 513 (Table 4). Total physical activity did not differ significantly ($p = .72$) between the urban and the rural groups. However, when exploring its constructions, by life domains, an interesting pattern emerged (Figure 8). The largest proportion of physical activity occurred in the household domain in both urban and rural areas. In the urban group, a significantly larger proportion of physical activities were carried out in leisure-time than in the rural group. However, in the rural group a significantly larger proportion of physical activity was related to work than in the urban group.

Results

Table 4. Characteristics of participants' and contextual factors, in total and by urban and rural residency

Characteristics & contextual factors	Mean (SD) [range] or N (%)			p‡
	Total† N = 186	Urban n = 118	Rural n = 68	
Personal factors				
Age, years	74 (6.3)[65-88]	74 (6.3)[65-88]	74 (6.2)[65-86]	.658
Age-group, ≥ 75 years	72 (39)	45 (38)	27 (40)	.832
Sex, male	97 (52)	56 (48)	41 (60)	.091
Education, years	7.5 (3.3)[0-20]	8.2 (3.6)[0-20]	6.3 (2.2)[3-13]	<.001
Health conditions, total no.	3.2(1.8)[0-9]	2.7 (1.6)[0-7]	4.1 (1.8)[0-9]	<.001
Falls ≥ 1/year	59 (32)	35 (30)	24 (35)	.449
Falls ≥ 2/year	21 (11)	10 (9)	11 (17)	.115
PASE, 0-400+	130 (96)[0-513]	128 (92)[0-504]	133 (104)[0-513]	.708
PASE-leisure, 0-400+	20 (36)[0-244]	24 (40)[0-245]	13 (28)[0-154]	.045
PASE-home, 0-171	82 (43)[0-171]	82 (43)[0-171]	73 (37)[0-141]	.118
PASE-work, 0-400+	32 (66)[0-420]	23 (49)[0-234]	47 (86)[0-420]	.019
Environmental factors				
Living alone	45 (24)	35 (30)	10 (15)	.022
Employed	33 (18)	23 (20)	10 (15)	.411
Adequate income	123 (66)	88 (75)	35 (52)	<.001
Walking aid	28 (15)	18(16)	10(15)	.882
Medications, total no.	3.7(2.5)[0-11]	3.8 (2.4)[0-9]	3.7 (2.6)[0-11]	.812
Home nursing service	16 (9)	10 (9)	6 (9)	.949
Social domestic service	63 (34)	39 (33)	24 (35)	.787
Body functions				
Balance confidence, 0-100	83 (18)[21-100]	85 (18)[34-100]	81 (19)[21-100]	.231
Depressive symptoms, 0-30	7 (4.3)[1-20]	6 (3.8)[1-20]	8 (4.6)[1-20]	<.001
Cognitive function, 0-30	27 (2.5)[16-30]	27 (2.5)[16-30]	27 (2.7)[21-30]	.732
Body mass index, kg/m ²	27(3.8)[139]	27 (3.8)[17-39]	27 (3.6)[19-36]	.872
Pain, 0-100	65 (41)[0-100]	73 (40)[0-100]	50 (37)[0-100]	<.001
Activities				
Basic lower extr., 0-100	76 (15)[42-100]	78 (16)[42-100]	74 (14)[48-100]	.110
Adv. lower extr., 0-100	56 (17)[0-100]	56 (19)[0-100]	56 (15)[18-100]	.904
Upper extr., 0-100	86 (15)[43-100]	90 (14)[50-100]	80 (14)[43-100]	<.001
Capacity to drive	111 (60)	68 (58)	43 (63)	.453
Basic mobility, seconds	11 (3.6)[5-24]	10 (3.4)[5-24]	12 (3.4)[7-23]	<.001
Participation				
Participation freq., 0-100	48 (5.5)[33-67]	49 (5.2)[34-67]	45 (5.2)[33-62]	<.001
Participation restr., 0-100	79 (16)[42-100]	83 (16)[42-100]	71 (11)[49-100]	<.001
General self-rated health				
Poor	14 (7.6)	8 (6.8)	6 (9.0)	.006
Fair	55 (29.7)	27 (22.9)	28 (41.8)	
Good	83 (44.9)	58 (49.2)	25 (37.3)	
Very good	28 (15.1)	20 (16.9)	8 (11.9)	
Excellent	5 (2.7)	5 (4.2)	0 (0)	

*Proportions (%) are based on valid data for each variable; †based on nonweighted data; ‡ p values indicate the significance of differences among urban and rural participants ;PASE-leisure = leisure time physical activity; PASE-home = household physical activity; PASE-work= work-related physical activity; adv. lower extr. = advanced lower extremity capacity; basic lower extr. = basic lower extremity capacity; adv. lower extr. = advanced lower extremity capacity; participation freq. = participation frequency; participation restr. = perceived participation restriction.

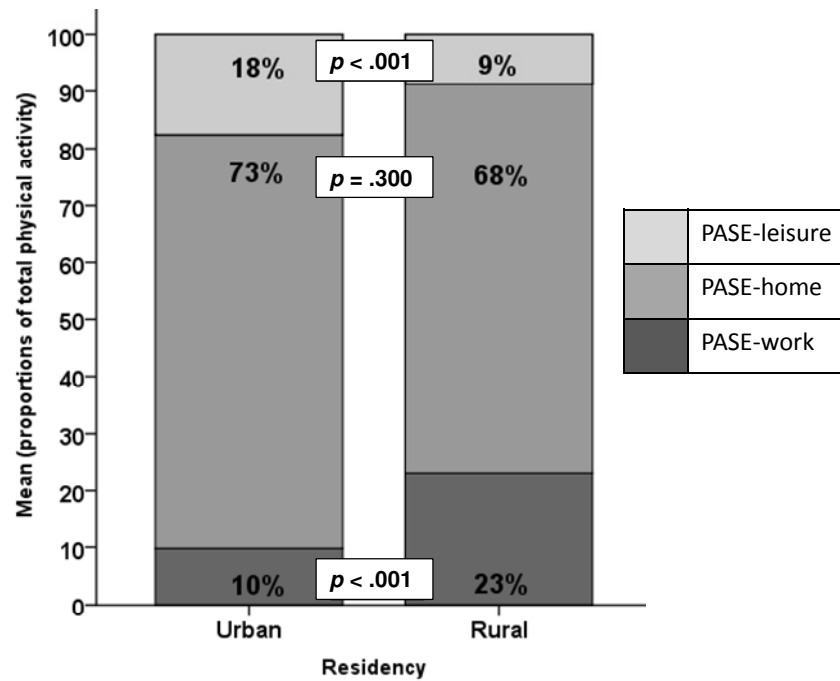


Figure 8. The proportional contributions of physical activity in three different life domains to the total physical activity by urban and rural residency. PASE-leisure = leisure-time physical activity, PASE-home = household physical activity, PASE-work = work-related physical activity.

The ANCOVA analysis (Table 5) revealed that men were more physically active in total than the women ($\text{mean}_{\text{adj}} = 115$ and 85 , respectively) and the younger group was more active than the older group ($\text{mean}_{\text{adj}} = 120$ and 82 , respectively). Residency had significant main effects on leisure-time physical activity as the urban group had higher scores than the rural group ($\text{mean}_{\text{adj}} = 12$ and 4 , respectively). Residency was also associated with household physical activity and interacted with gender. Thus, rural women were more active in household activities than urban women ($\text{mean}_{\text{adj}} = 89$ and 75 , respectively) while urban males were more active in the household than rural males ($\text{mean}_{\text{adj}} = 86$ and 78 , respectively). Additionally, the younger group was more physically active in household than the older group ($\text{mean}_{\text{adj}} = 89$ and 75 , respectively).

The binary logistic regression revealed that age and a two-way interaction between residency and gender were significantly related to the dichotomized PASE-work variable. The younger age group was more likely to be physically active in work than the older group ($\text{OR}_{\text{adj}} = 5.4$, $95\% \text{ CI} = 1.75\text{--}16.89$). With rural males as a reference group the odds for the other groups to be physically active at work were: urban males $\text{OR}_{\text{adj}} = 0.13$ ($95\% \text{ CI} = 0.04\text{--}0.46$), urban females $\text{OR}_{\text{adj}} = 0.10$ ($95\% \text{ CI} =$

0.03–0.32), and rural females $OR_{adj} = 0.09$ (95% CI = 0.02–0.37). Therefore, rural males are eight to eleven times more likely to be physically active at work than the other groups.

Table 5. The relationship between physical activity and residency, gender, and age (p values) with education, depressive symptoms, and timed basic mobility as covariates

Variables	PASE _{log}	PASE-leisure _{log}	PASE-home
Residency	.336	<0.001*	.571
Gender	.043*	.392	.998
Age	.038*	.301	.026*
Residency x gender	.092	.334	.033*
Residency x age	.240	.357	.837
Gender x age	.317	.433	.919
Residency x gender x age	.638	.788	.620
Education	.990	.820	.559
Timed basic mobility	.006	.046	.001
Depressive symptoms	.476	.250	.029

PASE_{log} = total physical activity; PASE-leisure_{log} = leisure-time physical activity; PASE-home = household physical activity; x indicates interaction; * = significant at $p \leq .05$.

Balance confidence: Rasch analysis (Paper II)

A total of 183 participants completed the ABC with scores on the ordinal scale ranging from 21 to 100 (mean = 83) (Table 4). Twenty-six persons received a maximum score of 100 indicating 100% confidence in maintaining balance and remaining steady when performing the 16 ABC items. Rasch analysis and Linacre's criteria¹⁵⁷ revealed a need to modify the ABC rating scale as participants were not able to differentiate reliably between the 11 rating scale categories of the ABC (Figure 9). Additionally, three items failed to show acceptable goodness of fit to the ABC rating scale model. We followed the simple guideline to collapse categories⁴ until the best solution of a 5-category rating scale was achieved. More specifically, the extreme categories from the original ABC were retained, and the intermediate categories were collapsed (such that 0 = zero%, 1 = 10% to 40%, 2 = 50% to 70%, 3 = 80% to 90%, and 4 = 100%). This modification resulted in reasonably equal distribution of ratings, advancing category measures, acceptable rating scale outfit statistics, and ordered threshold calibrations displayed graphically as five category probability curves with distinct peaks (Figure 9).

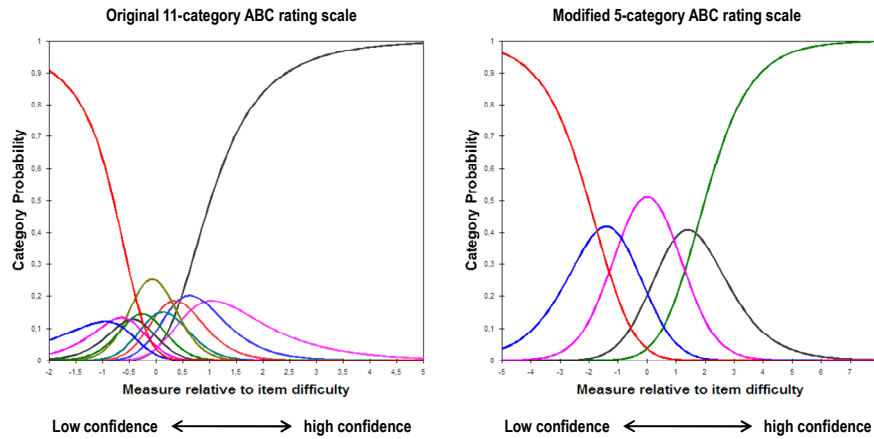


Figure 9. Category probability curves. Graphic presentation of how the probability of responses for each of the ABC rating scale categories changed when they were collapsed from 11 to 5. Source: A modified figure from Paper II.

By collapsing categories and creating a new 5-category scale, only one item misfit (“bend over and pick up a slipper from the front of a closet floor”). Removing that item resulted in a modified version of the ABC with five categories and 15 items. Both item goodness-of-fit statistics and principal components analysis supported unidimensionality of this modified ABC.

The ABC measures reliably separated the sample into at least four statistically distinct strata of balance confidence. Finally, the hierarchical order of item difficulties was consistent with theoretic expectations, and despite some ceiling effects the items were reasonably well targeted to the balance confidence of the persons tested. A person-item map (Figure 10) shows graphically the hierarchy and spread of participants and items along the common linear logarithmic scale (logits), for the 5-category and 15 item modified version of ABC.

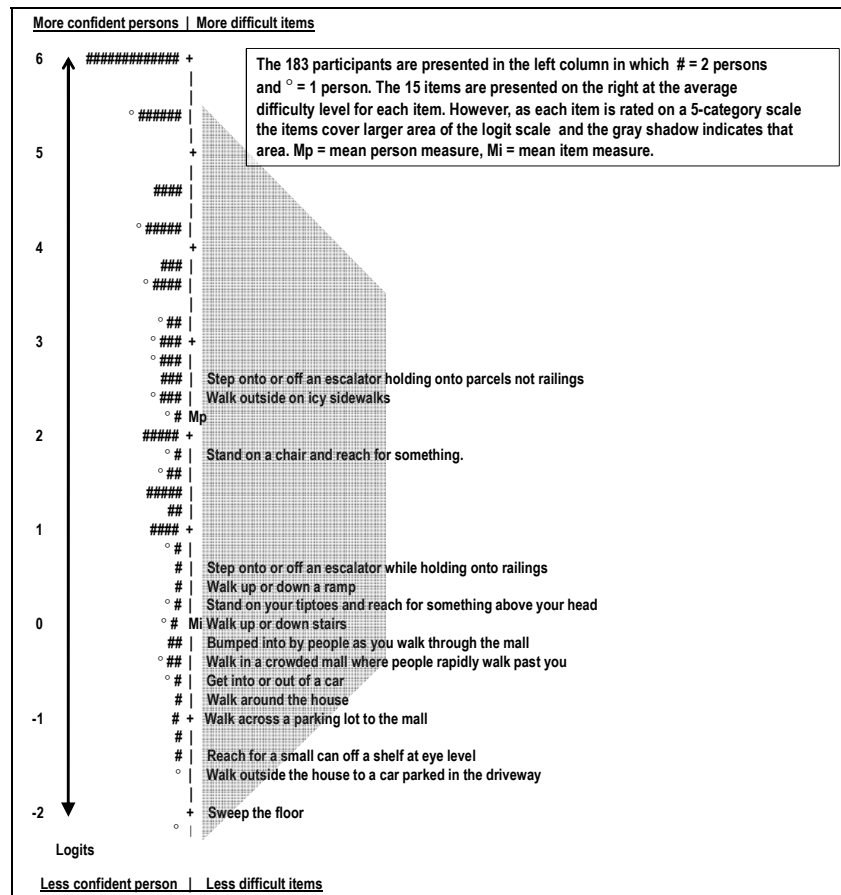


Figure 10. A person-item map indicating the spread of persons and items along a common logits (linear log-odds probability units) scale of the modified ABC.

Participation (Paper III)

Participation frequency measures ranged from 33 to 67 (mean = 48) and were considerably lower than the perceived participation restriction that ranged from 42 to 100 (mean = 79) (Table 4). Fifty participants (27%) reported that they did not perceive any restrictions at all in participating in the 16 LLFDI-D life tasks (a maximum score of 100). Of these 50 persons, 47 were from the urban area and only three from the rural area. Univariate analysis (Table 6) revealed that both participation frequency and perceived participation restriction were significantly associated with variables from all ICF components.

For participation frequency, a multivariate model made from personal factors was the strongest one of the ICF components models ($R^2 = .34$),

followed by a body functions model ($R^2 = .19$), an activities model ($R^2 = .16$), and an environmental factors model ($R^2 = .03$). For participation restriction, however, a multivariate model reflecting activities variables was the strongest one of the ICF components models (pseudo $R^2 = .27$), followed by the body functions model (pseudo $R^2 = .25$), personal factors model (pseudo $R^2 = .17$), and finally the environmental factors model (pseudo $R^2 = .04$).

Table 6. Participation frequency and perceived participation restriction and their associations with variables from ICF components (participation restriction: 0 more, 1 = less)

Variables	Univariate models				Minimal multivariate models			
	Participation frequency		Participation restriction		Participation frequency		Participation restriction	
	β	p	OR	p	β_{adj}	p	OR_{adj}	p
Personal factors								
Age	-0.31	<.001	0.95	.040	-0.18	.002	1.05	.228
Sex (0 = woman, 1 = man)	0.16	.856	1.98	.047	-1.22	.075	0.65	.385
Education	0.22	.035	1.00	.936				
Health conditions	-0.70	.009	0.58	<.001				
History of recurrent falls	-3.88	.005	0.10	.007	-1.87	.067		
Total physical activity	6.93	<.001	6.77	<.001	4.57	<.001		
Environmental factors								
Residency (0 = rural, 1 = urban)	3.51	<.001	4.83	<.001	2.82	<.001	5.47	.001
Living alone (0 = yes, 1 = no)	-0.27	.795	1.46	.323				
Employed	0.43	.675	2.22	.077			3.66	.011
Adequate income	-1.06	.260	0.79	.540				
Body functions								
Balance confidence	0.67	<.001	1.57	<.001				
Depressive symptoms	-0.51	<.001	0.75	<.001	-0.19	.029	0.83	.011
Cognitive function	0.80	<.001	1.12	.176	0.32	.009		
Body mass index	0.23	.083	0.99	.813				
Bodily Pain	0.02	.042	1.02	<.001				
Activities								
Adv. lower extremity capacity	0.10	<.001	1.08	<.001			1.09	<.001
Upper extremity capacity	0.05	.088	1.07	<.001				
Capacity to drive	3.65	<.001	2.33	.017				
Timed basic mobility	-0.48	<.001	0.64	<.001				
					$R^2 = .413$		Pseudo $R^2 = .318$	

The minimal multivariate model for participation frequency (Table 6) was adjusted for sex and history of falls. Higher participation frequency was associated with a more physically active lifestyle ($\beta_{adj} = 4.6$, $p < .001$), urban residency ($\beta_{adj} = 2.8$, $p < .001$), and higher cognitive function ($\beta_{adj} = 0.3$, $p = .009$). In the same model, lower participation frequency was

associated with being older ($\beta_{\text{adj}} = -0.2, p = .002$) and more depressive symptoms ($\beta_{\text{adj}} = -0.2, p = .029$).

The minimal multivariate model for participation restriction (Table 6) was adjusted for age and sex. Urban residency ($\text{OR}_{\text{adj}} = 5.5, p = .001$), being employed ($\text{OR}_{\text{adj}} = 3.7, p = .011$), and advanced lower extremity capacity ($\text{OR}_{\text{adj}} = 1.09, p < .001$) were associated with increased likelihood of less participation restriction. In the same model, the likelihood of more participation restriction increased with depressive symptoms ($\text{OR}_{\text{adj}} = 0.8, p = .011$).

Self-rated health (Paper IV)

Of the 185 participants that rated their health, the largest proportion (45%) rated their health as good, 37% rated their health as fair or poor, and 18% rated their health as very good or excellent. Table 4 presents the total, and by residency, SRH and shows that SRH was significantly lower among rural older adults than in those living in urban areas.

The univariate analysis revealed how SRH was associated with all analyzed ICF components through 16 standardized scales and nonstandardized sociodemographic questions (Table 7). The likelihood of a better SRH increased with scores indicating higher functioning on all variables reflecting body functions, activities, and participation. The likelihood of a better SRH also increased with a physically active lifestyle, being a man, and urban residency. However, the likelihood of a worse SRH increased with a higher number of health conditions. Age and adequacy of income were the only variables that did not have a significant univariate association with SRH. Older age, however, became significantly associated with better SRH ($\text{OR}_{\text{adj}} = 1.07, 95\% \text{ CI} = 1.01\text{--}1.13, p = .013$) when we controlled for advanced lower extremity capacity.

In an intermediate step where we created a model including all 18 explanatory variables (Table 7), the likelihood of a better SRH increased with higher age ($\text{OR}_{\text{adj}} = 1.10, 95\% \text{ CI} = 1.03\text{--}1.18, p = .004$) and decreased with higher scores on the GDS ($\text{OR}_{\text{adj}} = 0.82, 95\% \text{ CI} = 0.68\text{--}0.97, p = .023$). From this intermediate model we created the minimal multivariate model. The minimal model included five variables representing aspects of ICF's body functions, activities, and personal factors. In the minimal model, the likelihood of a better SRH increased with older age ($\text{OR}_{\text{adj}} = 1.09, 95\% \text{ CI} = 1.02\text{--}1.17, p = .006$), household physical activity ($\text{OR}_{\text{adj}} = 1.01, 95\% \text{ CI} = 1.00\text{--}1.02, p = .016$), advanced lower extremity capacity ($\text{OR}_{\text{adj}} = 1.05, 95\% \text{ CI} = 1.02\text{--}1.17, p < .001$), and upper extremity capacity ($\text{OR}_{\text{adj}} = 1.13, 95\% \text{ CI} = 1.00\text{--}1.16, p = .040$). However, this likelihood of a better SRH decreased with higher scores on the GDS ($\text{OR}_{\text{adj}} = 0.79, 95\% \text{ CI} = 0.70\text{--}0.88, p < .001$). Adjusting this minimal model for gender did not change the results. The pseudo R^2

Results

values revealed almost the same strength of the relationship between SRH and the variables in the full model (pseudo $R^2 = .25$) and the minimal model (pseudo $R^2 = .24$).

Table 7. Relationships between self-rated health and scores on standardized assessments and nonstandardized sociodemographic questions, commonly used in geriatric research and practice

Variables	Univariate models			Multivariate model (including all variables)		
	OR	95% CI	<i>p</i>	OR _{adj}	95% CI	<i>p</i>
Personal factors						
Age	0.97	0.92-1.02	.250	1.10	1.03-1.18	.004
Sex	2.47	1.30-4.67	.006	0.85	0.37-1.92	.699
Health conditions	0.55	0.46-0.66	<.001	0.89	0.66-1.20	.448
PASE-leisure	2.53	1.43-4.50	.002	1.16	0.57-2.31	.683
PASE-home	1.02	1.01-1.03	<.001	1.01	0.99-1.02	.064
PASE-work	2.16	1.11-4.20	.024	1.30	0.61-2.77	.492
Environmental factors						
Residency	2.17	1.25-3.76	.006	0.66	0.22-1.95	.454
Adequate income	1.13	0.56-2.27	.744	0.85	0.36-1.98	.709
Body Function						
Activities-specific Balance Confidence scale	1.59	1.35-1.86	<.001	1.12	0.79-1.56	.516
Geriatric Depression Scale	0.70	0.62-0.78	<.001	0.82	0.68-0.97	.023
Mini-Mental State Examination	1.19	1.03-1.39	.020	1.04	0.85-1.28	.688
Bodily Pain	1.02	1.01-1.03	<.001	1.01	0.99-1.02	.134
Activities						
Basic lower extremity capacity	1.07	1.05-1.10	<.001	0.98	0.92-1.03	.391
Advanced lower extremity capacity	1.06	1.04-1.09	<.001	1.03	0.99-1.07	.057
Upper extremity capacity	1.07	1.05-1.09	<.001	1.02	0.98-1.06	.251
Timed Up & Go	0.73	0.64-0.84	<.001	0.89	0.72-1.11	.325
Participation						
Participation frequency	1.13	1.03-1.22	.005	1.00	0.91-1.09	.995
Perceived participation restrictions	6.66	3.22-13.78	<.001	1.48	0.58-3.74	.411
Pseudo $R^2 = 0.25$						

PASE-leisure = leisure time physical activity; PASE-home = household physical activity; PASE-work = work-related physical activity.

The explanatory variables were measured on very different scales. Therefore, caution is needed when comparing the association between the explanatory variables and SRH. For example, the upper and lower extremity capacity measures and the PASE-home scale have a much larger range than the GDS. Hence, in Figure 11 we present additional information on the likelihood of a better SRH per one standard deviation unit for each explanatory variable in the minimal multivariate model.

Results

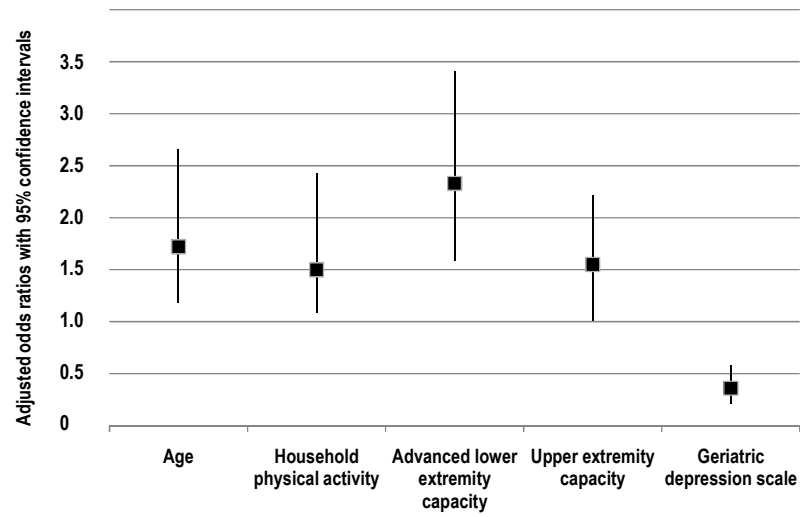


Figure 11. The likelihood (adjusted odds ratios) of better self-rated health per one standard deviation unit of each explanatory variable in the minimal multivariate model.

DISCUSSION

The research presented in this thesis supports the use of a broad conceptual view of total *physical activity*, as older people may be filling their physical activity quotient through active life-style in leisure, household, or work domains. The total and domain specific physical activity was, at a varying degree, associated with older people's participation, self-related health, residency, gender and age. The results reinforced that *participation frequency* and *perceived restrictions to participation* should be assessed separately. Both aspects of participation had a strong relationship with depressive symptoms and residency, but otherwise they were associated with different variables representing various ICF components. *Self-rated health* was also associated with multiple variables from various ICF components. Its strongest relationship, however, was with depressive symptoms, upper and lower extremity capacity, age, and household physical activity. Rasch analysis suggested modifications of a scale towards an improved quality in measuring *balance confidence*. Balance confidence, however, did not play a major role in explaining participation or self-rated health. Finally, the ICF was useful as: (1) a conceptual framework for selecting a broad variety of variables representing aspects of older people's functioning and health, (2) for mapping personal characteristics and contextual factors, and (3) to facilitate analysis and understanding of multiple aspects of functioning and health.

The interplay between contextual factors, functioning, and self-rated health

Physically active lifestyle, its residency-based patterns, and its associations with participation and self-rated health

The initial focus in our research was on the personal factor of a physically active life-style (Paper I). Exploring the total physical activity level, and controlling for education, timed basic mobility, and depressive symptoms, our results support other studies reporting less physical activity with advanced age and less physical activity among women than men.¹⁶⁴ Interestingly, when focusing on leisure-time physical activity, the urban versus rural residency outweighed these much more discussed effects of age and gender. The urban versus rural residency, however, was not associated with the total physical activity level. Therefore, although our rural older residents were less physically active in leisure-time than were the urban seniors, we claim that such information does not provide enough basis for statements that rural seniors are less physically active

than older people in urban areas.^{165,54} Less leisure-time physical activity in rural areas may be related to longer distances, possible lack of transportation, and lack of organized recreational and exercise groups in the rural community.¹⁶⁶ However, according to our study, in rural areas leisure-time physical activities may have been irrelevant to a large part of the older group as they chose other means to fill their physical activity quotient. The rural women had the highest household physical activity scores and the rural men had by far the highest prevalence of physically demanding work among males. Based on information like this, some researchers have even claimed that the narrow view of physical activity as merely leisure-time activities should be abandoned.¹⁶⁷

Various types of regular exercise in leisure-time, however, are still rated the most important part of a physically active life-style as scientific evidence on the health benefits of household- or work-related activity is still lacking.⁷⁴ Therefore, it is worth noticing that in our study leisure-time physical activity constituted a very low proportion of the total activity level, while our results support other studies presenting household as the most common venue for physical activity in daily life.^{132,134,168-170}

Our focus on work-related physical activity is rarely seen in research within this age group. The physical activity pattern in daily life is based on the will and the opportunities to carry out such behavior. Passing the retirement age may be a well accepted opening to leave the working area of activities, or working may not even be an option due to social or health constrictions. In a major review on the life of older U.S. farmers, however, researchers highlighted how the large majority of older farmers continue to work well past an official retirement age.⁵⁷ Accordingly, those who scored highest on PASE-work in our study were older farmers in the middle of a haying season.

Higher levels of leisure-time physical activity have been presented as the most significant predictors of SRH in age 50 and older adults across 11 European countries.¹⁷¹ By analyzing physical activity in contexts other than leisure-time we were able to introduce new information on how SRH in old age is associated with a physically active lifestyle related to leisure, household, and work (Paper IV). Of these three life domains, physical activity in the context of household had the strongest relationship to SRH further supporting the importance of including a broad view on physically active life style in research on health and aging.

Acknowledging a holistic view on a physically active lifestyle is in keeping with a widely accepted physical activity definition⁷ basing physical activity on any bodily movement produced by skeletal muscles that results in energy expenditure. Modern physical activity recommendations for older adults also highlight older people's opportunities to fill their health-promoting physical activity quotient through their daily activities.^{73,74} Accordingly, in our research the total physical activity level was one of few

variables to be independently associated with a higher participation frequency (Paper III).

Balance confidence in context and improvements of a scale

In the next part of our research we focused on the concept of balance confidence (Paper II) which we linked to the body functions part of ICF. We incorporated balance confidence into the assessment battery of the study as it is a fall-related psychological factor which may act as a mediating factor between inactivity, physical activity, participation,⁹⁸⁻¹⁰⁰ and perceptions of health. We assessed balance confidence with the ABC scale, which we analyzed with Rasch methods and modified accordingly to improve its measurement properties.

The Rasch analysis revealed a major problem with the 11-category ABC rating scale as a large proportion of the available categories were underused. As we noted earlier, this situation can occur when participants are unable to distinguish among similar rating categories. Our results indicated that a modified 5-category version of the ABC may make it possible for persons to reliably differentiate between available categories. Thus, the 5-category scale might provide a simplified scoring method for users.

Another problem detected was that the “pick up a slipper” item failed to show acceptable fit, indicating it may represent a different construct. The ABC items represent activities performed during position changes, standing, or walking.² Thus, the reason for the misfit may be related to the fact that this particular item differs from the other ABC items such that it either does not represent an activity performed during position change, or it also captures something other than activity performed during position change. We speculate the latter: bending down to pick up a slipper requires a person to bend down, which is closely related to dizziness and unsteadiness and may therefore “capture” concerns about falling which are unrelated to the person’s general perceptions of his or her own ability to maintain balance in daily activities.

A part of the validation of a scale involves determining if the hierarchical ordering of the items is consistent with theoretical or clinical expectations. Overall, our item hierarchy was similar to what has previously been reported.^{2,143} Some differences were also noted, such as the fact that “walking on ice” came second in the difficulty hierarchy of our study even though it was the item that was described as the most “threatening” on the original ABC² and a hazardous task that should be avoided by seniors on a simplified version of the ABC.¹⁴³ However, “stepping onto or off an escalator while holding onto parcels” was the most difficult item in our study. An explanation might be traced to the situation specificity of self-efficacy or confidence,⁹⁷ along with the fact

that Icelanders, given their climate, are more experienced with walking on ice than stepping on or off an escalator. The ceiling effects of the ABC have been discussed elsewhere¹⁷² and floor effects were not a problem as the ABC items were well targeted to those participants who had some problems with balance confidence. The easiest rating scale categories on the ABC interval scale were not used by our community-dwelling participants. These categories, however, are likely relevant for older people with more disabilities.

The potential mediating role of balance confidence may be the reason that the ABC measure did not play any main role in later parts of our study. Although balance confidence had a significant univariate relationship with participation frequency, perceived participation restriction (Paper III), and SRH (Paper IV), other variables were stronger and contributed more uniquely to these three phenomena in the multivariate analyses. These results have to be interpreted in the light of our cross-sectional study design where balance confidence was set out to compete statistically with many other explanatory variables. However, the modified Icelandic version of the ABC is now available for future studies on this interesting phenomenon, pending cross-validation of our revised version with other disability groups and/or in different cultural contexts.

Participation frequency, perceived participation restriction, and self-rated health

In the two latter parts of our study, participation (Paper III) and SRH (Paper IV) were the main outcomes of interest. Participation has been introduced as the most important part of functioning⁶⁷ which according to ICF is a health related state,¹ and SRH has been described as one of the most important client-oriented health outcomes available.¹⁷³

Our study results reflected the breadth and complexity of both these phenomena as they had univariate associations with variables from all ICF components. By comparing the three minimal multivariate models for participation frequency, perceived participation restrictions, and SRH, we were able to highlight certain explanatory variables that stood out by their strong and independent association with participation and SRH. Figure 12 is a schematic representation of these associations. Physical activity and its relationship with participation and SRH have been discussed earlier in this thesis. Following are discussions on the other factors which were independently associated with participation and SRH in our study.

Depressive symptoms had the strongest relationship with all the main outcomes in this thesis. An association between depressive symptoms and lower participation frequency harmonizes with results from studies on older people with visual impairments¹⁷⁴ and community-dwelling people aged 50 years and older.¹⁷⁵ Also, the robust relationship between a worse

SRH and depressive symptoms has been well described in other studies in older populations.^{171,176}

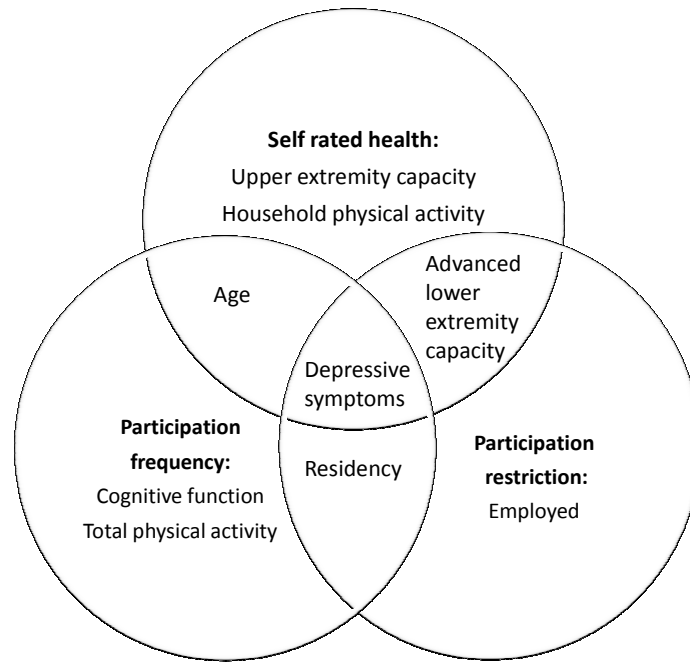


Figure 12. A schematic presentation of the variables that had the strongest relationship with participation frequency, perceived participation restriction, and self-rated health.

Previously, poor SRH has been associated with lower extremity disability measured with a rapid timed gait task in older community-dwelling urban people¹⁷⁷ and self-reported mobility difficulties in adults aged 50 and older across 11 European countries.¹⁷¹ In our study, we used a measure of advanced lower extremity capacity which was derived from the LLFDI-F and includes self-report on 11 physically challenging items.¹²⁹ Based on a Rasch analysis the easiest item on this scale is “walking several blocks” and the most difficult is “running half a mile”.¹²⁰ Notably, items of such a high difficulty level as in the LLFDI-F are usually not a part of participation or SRH studies involving older people. Based on our study, however, such highly challenging items are appropriate to use in the general community-dwelling older populations as they were strongly associated with perceptions of participation restrictions and general health. Importantly, advanced lower extremity capacity is also a factor that has a potential to improve with proper interventions.

Interestingly, age played different roles based on its context. Although older age was associated with less frequent participation, age did not have an independent relationship with perceived participation restrictions and

finally older age was associated with a better SRH. Other studies have reported more participation restrictions in older age groups compared to younger^{175,178} and the SRH association with age is much discussed.¹⁰⁶ It may seem paradoxical that older people report the same or better perceived health status at ages where health is expected to decline and disabilities to rise. Yet, this lack of agreement between the “internal” self-ratings of health and “external” assessments of health conditions is well known, both in cross-sectional and longitudinal studies on older cohorts.^{102,106} The Response Shift Theory¹⁷⁹ has been used to explain how an acquired disability or some loss in life can cause a shift or a change in personal perceptions of health.

Rural residency was independently associated with a negative outcome on both participation assessments. This robustness of the residency variable is in contrast with results from a Canadian study where participation did not differ between groups of older adults living in metropolitan, urban, and rural areas.⁶⁶ Our results are, however, indirectly supported by multiple studies highlighting the importance of the environment in participation.^{51,65,66,180,181} Residency has been described as a value-loaded variable⁵⁷ which results in multiple ways to link this variable to the ICF environmental component through categories such as population density, physical geography, transportation services, and social norms.¹

Although one may expect the urban versus rural environment and participation (which strongly involves environmental context) to have a connection to SRH, our results were in accordance with a study on French and British working-age cohorts.¹⁸² In that study, SRH was shown to have the firmest grounds in an individual’s aspects of physical and mental health, while environmental and other sociodemographic factors contributed less to SRH.

Self-report on upper extremity capacity had a strong relationship with SRH. The standardized instrument we used (LLFDI-F)¹²⁹ includes seven items that reflect activities of the hands and arms, and range in difficulty from “holding a full glass of water” to “unscrewing the lid off a previously unopened jar”.¹²⁰ Other research has reported an association between SRH and upper extremity performance in older people.¹⁸³

In our study, employment status was conceptualized as an indicator of a certain societal role to be filled. Moreover, it implies a more flexible income than, for example, when depending solely on a fixed old-age pension. Therefore, being employed (and on a payroll) was linked to the environmental factors of ICF and actually hypothesized to be a general facilitator for functioning. Interestingly, our study revealed that being employed was associated with less participation restrictions. Yet, a concern should be raised regarding using LLFDI-D to assess participation among older Icelanders as this instrument has no items on participating in work for pay. Iceland is known for its very high labor force participation of older workers compared with other industrialized

countries, and consequently has a high average age of retirement among both women and men.^{184,185}

The independent association found between higher cognitive function and more frequent participation is in line with longitudinal studies associating cognitive and physical training to improvements or maintenance of cognitive function in old age.^{186,187} Yet, our study raises questions regarding the direction of this relationship between participation and cognitive function and on the psychometric properties of our assessments when used in older populations with cognitive impairments.

While participation frequency and perceived participation restriction may be pictured as two sides of the same coin, our results showed otherwise. Firstly, as discussed above, these two aspects of participation were partially associated with different sets of variables. Secondly, low participation frequency is not necessarily related to high perceived participation restrictions and vice versa. As an example, despite less participation restrictions the individuals in our study participated less frequently than was seen in a U.S. sample of community-dwelling older adults with activity limitations.⁶⁵ Such a gap between the two aspects of participation may be related to the importance, opportunity, and the will to perform the life tasks included in the LLFDI-D instruments. It may indicate that the older community-dwelling population has a reserve ability to participate more frequently if and when needed or desired. Additionally, this gap also highlights the different meaning of each aspect of participation and thereby the importance of capturing both of them to better understand the prevalence of participation and to detect meaningful changes in older persons' participation.^{51,65,69-71,130}

Our participants rated their general health as relatively bad if compared to a 60 years and older random sample of non-institutionalized adults in the U.S.¹⁸⁸ Such differences in SRH distributions between cultural and language regions have been seen within European countries¹⁷¹ and within ethnic groups in the U.S.¹⁰⁶ and do have to be considered when generalizing research results on SRH. These differences have been related to factors such as: (1) differences in the true multidimensional aspects of health, (2) the process of health evaluation, (3) language and semantic issues, and (4) reporting style.^{106,171}

Methodological considerations

Study design

The study design was cross-sectional and provided prevalence data on many outcomes. Such a design is useful for public health planning, to generate hypotheses, and for instrument testing.¹¹³ However, this type of design makes it difficult to separate cause from effect, so causality could

not be inferred from our results. Additionally, the data were collected at one point in the summer and early fall. These months are the warmest and brightest months of the year in Iceland and haying season among the farmers, which may influence the outcome on variables such as physical activity behavior.

Participants

The study sample was drawn from geographical clusters in Northern Iceland that were selected purposefully to reflect older populations fulfilling the set criteria for urban and rural areas. This selection can certainly affect the generalizability of the results. It should, however, be kept in mind that close similarities may exist between Iceland and other Northern geographical areas of the world where the culture is labeled as Western.

The sample size was relatively small and fixed because of the study budget. Such a situation increases the risk of type II error. To optimize the power of the study, however, we used continuous data where possible and used residence-based clustered sampling with unequal sample sizes to ensure enough rural representatives in the sample.¹¹⁷ Therefore, to get a correct relationship between the variables, sample weights had to be applied in all inferential statistics requiring “summing across residency”.¹⁵⁶

The strength of our small but representative population-based sample should also be noted. First, we included rural populations that are often underrepresented in research on aging. Second, the study population was randomly selected and the response-rate of 79% was good compared to a recent Icelandic postal survey on general health.¹⁸⁹ The average response rate in that survey was only 50% and was particularly low among farmers that had reached at least 70 years of age. Third, as our inclusion criteria were generous, the sample should be representative of the older populations living in the study areas and reflect aspects of the diversity and variability of community-dwelling seniors. Fourth, administering an assessment battery in face-to-face interviews and tests is time-consuming and costly compared to postal surveys or telephone interviews. We do, however, believe that the face-to-face administration maximized the participation rate; gave people with some vision, fine motor or cognitive impairments the chance to participate; and improved the overall quality of our data.

As our goal was to reflect the diversity of the community-dwelling population we decided not to exclude people based on the commonly used MMSE criteria of 24.¹²⁶ Instead of a formal cognitive test, we used as an inclusion criterion that participants had to be able to communicate verbally by telephone and set up a meeting time. As mentioned, however, five of the potential participants were not included as they did not fulfill

this particular inclusion criterion according to caregivers' report. Our decision was based on a call for more research including older people with varying cognitive functions and McHorney's¹¹¹ claim that it is no longer appropriate or defensible to routinely exclude people with known or suspected cognitive impairment from reporting on their health status. Researchers have to anticipate that people with cognitive impairments may take longer to complete an assessment battery and have more missing data. However, their responses may yield reliability estimates that meet standards for group comparison purposes and their response may have validity comparable to that of cognitively intact patients.¹¹¹

Assessments

Our data were based largely on self-reports which are inherently subjective and rooted in individual personality, outlook, and context. Nevertheless, research in a wide variety of contexts support the use of self-reports in older populations.¹⁹⁰ Importantly, the standardized assessments we selected for this research share a relatively low respondent and administrative burden, which in turn largely increases their feasibility in research and in practice.^{110,111} This is a very important attribute, as the length of time required to complete an assessment is one of the main barriers for physical therapists using standardized outcome assessments.¹⁹¹

We selected the PASE questionnaire for our study as it was one of few standardized physical activity questionnaires designed for older populations and that acknowledges how energy can be spent in different life domains.¹¹⁸ Although the PASE was originally not designed to be partitioned, we did so to provide informative results on physical activity in different life domains. Other studies have used the subscales of PASE in similar ways¹³¹ and evaluated their intra-rater reliability in older rural people.¹³² However, our reliability study resulted in relatively low ICC values for the PASE-leisure subscale compared to PASE-home and PASE-work. This may be due to actual variability in the participant's habitual physical activity. More research is needed on the psychometric properties of the PASE subscales.

To analyze the psychometric properties of the ABC scale we implemented a Rasch analysis with and without the participants with MMSE scores under 24. Since the results were essentially identical, we reported only results from the entire sample. This is consistent with a recent study revealing good to excellent measurement properties of two falls efficacy scales in frail geriatric patients with moderate cognitive impairment (MMSE = 17–23).¹⁹² The researchers also recommended an interview administration mode, as we used in our study, to increase the test-retest reliability, the internal reliability, and the completion rate of the assessments.

Although missing data was generally not a problem in our study, the perceived participation restrictions measure was an exception to this rule. The inclusion of people with lower levels of cognitive functioning may partially explain this. In the participation restriction part of LLFDI-D, respondents are asked to rate their perceived restriction due to factors such as health, physical or mental energy, transportation, accessibility, or socioeconomic conditions.¹²⁰ Thinking about all these factors while answering each question requires the respondent to cognitively combine multiple experiences. Such problem solving may be particularly difficult for older individuals with some cognitive impairment.¹⁹³

Finally, in the case of PASE-work and perceived participation restrictions we had to dichotomize continuous variables as they were extremely skewed, thus making them inappropriate for parametric statistics in their original continuous forms. This, however, decreased the power of the study. Additionally, as there are no validated cut-offs available for these assessments this kind of dichotomizing limits the possibilities of making comparisons across studies.

A crosswalk between different conceptual worlds

Conceptual framework for health and disability studies

“For all health status applications, it is crucial that the measurement tool or the selected health concepts match one’s theoretical framework and not vice versa”.^{111(p.581)} This quote is related to the main limitation we experienced when working with ICF in our research. Those researchers and practitioners who in the last nine years have used ICF as a conceptual framework have undoubtedly come across comparable problems in selecting assessments to match the ICF frame. Such problems may be based on: (1) the fact that most of the available standardized assessments were developed within another conceptual model or even with no reference to a conceptual model at all, (2) the lack of conceptual clarity within the ICF when it comes to participation and personal factors, and (3) that the detailed ICF classification system can be restrictive when it comes to matching an assessment from another “conceptual world” to the ICF.

Therefore, despite the available linking rules^{109,112,194} the crosswalk between ICF language and the existing assessments related to late-life functioning and health are far from being precise and embracing the ICF language can be a challenge. An example of this challenge was our use of the LLFDI subscales to measure the participation and activities domains in this study. We decided to base our operational definitions and the linking of participation and activities variables, on the assumption that the ICF and Nagi’s conceptual frameworks are comparable despite differences in terminology.^{41,42}

Despite these limitations, working with the ICF in this study supported its strength as a conceptual framework to organize thoughts and to encourage that major factors of interest are not omitted from research or practice. The ICF gave us a broad picture of our outcomes and its neutral terms made it particularly appropriate for use in our participants who represented a general population of older adults where health and disability may vary greatly. The simple and diagrammatic presentation of the ICF's conceptual model was useful when it came to explaining and interpreting the outcomes and its association with explanatory variables.

Finally, the ICF may be an answer to a call for improvements in disability models allowing for the fit of physical activity, disuse, and physiological aging independently of pathology or chronic disease and injury.⁴⁸ Confusion in where to place physical activity within disability models may be related to failure in identifying the key concept in physical activity questionnaires. The main aim when administering physical activity scales such as the PASE is to capture life-style or behavioral parts that include varying levels of habitual physical strain. Although these questionnaires routinely include daily tasks to lead the respondent through reporting on the amount of habitual physical strain, the main aim is not to assess the individual's body functions, capacity in a standardized environment or participation in real-life situations. Therefore, from our perspective, physical activity must be categorized among the personal factors.

Test theories

In rehabilitation sciences, increased emphasis is being placed on the use of interval and ratio scales and the use of modern test theory methods such as Rasch analysis to construct measures of human behavior and perceptions.¹⁹⁵ Rasch analysis is based on a statistical model that complies with the fundamental assumptions made in measurements in physical sciences.⁴ Rasch analysis can be used to transform cumulative ordinal raw scores (achieved by participants-across items, or by items across participants) into linear continuous measures of ability (for participants) and difficulty (for items).⁴ Rasch modeling is based on the assumption that items within an assessment can be hierarchically ordered by difficulty along a linear scale. This item difficulty is calculated from the total number of persons in an appropriate sample that completes that item. Similarly, persons can be hierarchically ordered by ability along the same linear scale, and each person's ability is calculated from the total number of items the person completed successfully.

However, most of the standardized assessments commonly used within the area of aging are still based in classical test theory¹⁹⁶ and most of them are designed to be used based on total ordinal scores. When preparing our research we attempted to find standardized assessments that had been developed or modified using Rasch analysis or had an interval or ratio scale through other means. The LLFDI was one of the few standardized

assessments we found that fulfilled this criterion along with assessing a construct of interest. Additionally, we decided to use Rasch analysis to study the psychometric properties and modify the scale we selected to assess balance confidence in our study. Analogous to terminological confusion related to different disability models, different testing theories carry their own terminology that may cause confusion. We decided to take on the challenge to mix classical and modern testing theories in this study, based on our firm believe that all efforts to improve measurement of health and health-related states should be useful.

Implications for practice

The research behind this thesis has developed some new knowledge on aging in context, physical activity, participation, and health that may be translated into interdisciplinary or physical therapy practice within the area of aging. As the study is population based, some of the practical implications may stand closer to public health initiatives, though many of them should also be considered in relation to rehabilitation or clinical practice.

Through our research we have provided some basic information on the level of older Icelanders' physical activity, participation, and health that can be used as a reference in both public health and rehabilitation contexts. Through our translations and psychometric testing, we have also increased the availability of Icelandic standardized assessments, including quality linear measurements, for use in practice and research. As an example, our results support the application of a modified version of the ABC to assess balance confidence in an Icelandic urban and rural context. In practice, it is possible to continue to use the original version of the ABC scale but to create conversion tables, based on our suggested modifications, to facilitate transformation of the ordinal ABC scores to equal-interval ABC scores.

Regular physical activity in old age remains a critical and unmet challenge of the 21st century.¹⁹⁷ The promotion of physical activity for older people should consider personal characteristics, behavior, and environmental context. Our results emphasize the importance of such efforts to account for the potential effects of age, gender, and residency on the physical activity pattern. Every individual has a physical activity quotient which is limited by factors such as hours per day and one's capacity to stay active through longer periods. Professionals have to respect that an older person may be filling this physical activity quotient in life situations other than leisure-time. An older person who spends much energy in household or work-related physical activity may, for example, have little energy or time left for exercise. Also, historically people have maintained their strength and endurance through purposeful physical activity, such as manual labor on a farm.⁷⁴ Such ways to maintain and improve health may still be legitimate although today's focus in research and practice is on increasing

physical activity through exercise programs. In all practice where physical activity is in focus, we should aim at assessing the physical activity level by standardized means. The PASE is an example of a feasible and standardized scale for collecting data on older people's physical activity behavior in different contexts. Such data may potentially be used when developing and assessing the effects of a physical activity promotion plan for community-dwelling seniors.

A general aim within physical therapy is to bring meaningful functioning back into the life of those who seek our service.^{198,199} To maintain our focus on this aim, one way may be to systematically complement our assessments with general client-centered outcomes focusing on participation and self-rated health. Our results indicated that participation frequency and perceived participation restriction should be assessed separately these outcomes were partially associated with different sets of explanatory variables. Additionally, although the participation frequency provides important information on the older person's engagement in the LLFDI-D life-situations, perceived participation restriction is the client-centered aspect of participation which would certainly be the focus in client-centered practice. Therefore, the LLFDI and the single-item self-rated health question: (1) are feasible assessments to facilitate considerations of clients' perspectives of their life-situation, (2) enhance our focus on the real-life consequences of disability, and (3) may assist in determining the effects of interventions aimed at improving functioning.

Translating a holistic vision of participation and health into practice is a challenge as these phenomena are by nature complex. Consequently, the results should potentially be rewarding for our aging clients as the building blocks of participation and health may reveal multiple possibilities for intervention through the older individual and his or her context. Therefore, we encourage physical therapists to incorporate a sound conceptual framework into their practice. The concepts underlying the ICF have been embraced by physical therapists over the world.^{41,200-202} Using the ICF framework supports a holistic approach to the functioning, health, and well-being of older clients. Thus the ICF facilitates interdisciplinary thinking at the same time as it may help to identify areas that are within the scope of physical therapy.

In our research on participation and SRH we incorporated some assessments of constructs that may be of particular interest for geriatric physical therapy due to their intervention potential. Although our cross-sectional study design does not allow us to claim causality it is worth noting some of these variables (Figure 12). First, high scores on advanced lower extremity capacity were related to a better SRH and less perceived participation restrictions. Upper extremity capacity was also independently related to better SRH. Both variables indicate individual physical capacity that may be improved, for example through proper physical therapy and physical activity interventions.⁷⁴ In the context of

compression of morbidity,²⁵ we may have to start focusing on more challenging items than are usually to be found in traditional assessments and intervention approaches that have been developed with the older population in mind. Older community-dwelling people today and in the future may base their preferred participation levels and perceived health on activities that require advanced physical capacity. Second, depressive symptoms played a large role in less participation frequency, more perceived participation restrictions, and a worse SRH. Depression is a treatable condition but if left untreated there is evidence of an increased risk of morbidity and mortality and an associated economic and societal burden.²⁰³ Physical activity has been presented as one of the most important modalities to prevent and treat depression in the older population.^{74,203,204} Third, physical activity was indeed one of the variables independently associated with both participation frequency and SRH in our research. More specifically, total physical activity was associated with more participation frequency and household physical activity was associated with better self-rated health. Both of these aspects of physical activity go beyond the traditional focus on exercise and may be indicative of an important stepping stone toward optimal participation and perceived health. Notably, our results also highlight the importance of assessing the plausible facilitating or hindering aspects of an urban and rural residency to the older individual's participation.

Finally, many of the variables which were only associated with participation and SRH in univariate models may be important in a practical context. They may direct a physical therapist towards specific interventions to optimize participation and perceptions of health in older clients. For example, enhancing confidence in maintaining balance in daily activities or alleviating pain related to musculoskeletal impairments are potentially important links between physically active behavior and functioning and health in old age.

Future research

Inevitably, there remains a need for future research aimed at replicating and extending the current findings with larger and more diverse samples. Longitudinal research is needed to gain deeper insights into the relationships of the variables in the study, such as causality or directions of relationships. In such studies the ICF conceptual model can be used as a building block to create models for exploring potential causal links.

The results of our study on a small but well-defined population of older community-dwelling Icelanders may be the first steps towards a national database providing reference values for older people's functioning and health. Further research into contextual aspects of aging in Iceland should be encouraged with the aim of optimizing health and well-being in old age.

Continuing research is needed on the psychometric properties of the standardized assessments used in our study (such as PASE), both in Icelandic and an international context. Importantly, we should also aim for more research on the psychometric properties of these assessments when used in populations with known or suspected cognitive impairments. Application of modern test theories is encouraged in these processes to determine whether quality linear measures for use across a range of languages and relevant cultural contexts can be developed. In our study we took a step in that direction by using Rasch analyses to assess the psychometric properties of the ABC. Participants responded to the original 11-category ABC scale, which we then recoded. Further research, however, is needed to determine if comparable results are obtained by having persons respond directly to a 5-category scale rather than an 11-category scale.

Physical activity recommendations use the term physical activity to indicate that exercise programs are not the only way to meet the recommendations.⁷⁴ Yet, scientific evidence is still lacking on the direct health benefits of physical activity in contexts other than leisure-time exercise. As an example, the association between household physical activity and self-rated health seen in our study deserves further attention. Therefore, studies with a broad perspective on the effects of a physically active life-style are much needed, and particularly on the potential effects of work-related and household physical activities on health in old age. Also of interest, is to explore the mechanisms behind the potentially different health effects of physical activity, depending on its context. The PASE may be a feasible scale for assessing physical activity in such research.

Further research into the variables associated with participation frequency, perceived participation restriction, and self-rated health is important. We believe it would be particularly interesting to explore further the potential benefits of advanced lower extremity capacity in old age, and if physical activity and therapeutic regimens can be used to optimize older individual's participation and perceptions of health through improved physical capacity. Additionally, the older individual's cognitive function and its association with participation frequency and the potential effects of exercise interventions, deserves more attention. Interestingly, neither participation frequency nor participation restriction was independently associated with self-rated health in older age. Therefore, future studies should investigate if there are other sides of participation at the center of self-rated health, such as the will to participate.

Studies on aging should carefully incorporate the potential effects of and interactions with the environment. Further research is needed on the effects of residency-based differences in physical activity patterns and why older rural people participated less frequently and perceived more participation restrictions than urban seniors. In the light of the debate in

Western societies about raising retirement ages and enabling people to work longer,¹³ researching older person's employment versus pensioner status and its association with perceptions of participation restrictions would be appropriate.

CONCLUSIONS

The following conclusions can be drawn from the results of the study presented in this thesis:

Older Icelanders in rural areas should not be labeled less physically active than those who live in urban areas as there was no difference in the total physical activity level between these two groups. However, the differences in the underlying physical activity patterns point to the use of dissimilar ways to fill the physical activity quotient in an urban versus a rural environment. Therefore, the results reinforce the need to pay close attention to the environment when studying and developing strategies to promote physical activity. Additionally, the importance of a physically active lifestyle in different life domains was highlighted by its association with both frequency of participation and self-rated health in old age, which further emphasizes the potential of the promotion of physical activity.

Rasch analysis indicated a need to modify the ABC scale to improve its psychometric properties when applied in a new Icelandic context. This modified version of the ABC was useful for generating a measurement of balance confidence for statistical modeling of its association with participation or self-rated health. Our results reinforce the need to analyze the original version as well as any existing translations of the ABC to determine if similar modifications are indicated. Such analysis can also be used to ensure the cross-cultural validity of the ABC.

The importance of assessing both frequency of participation and the more client-centered perspective of perceived participation restriction was highlighted, as these two aspects of participation were associated with distinct sets of variables. Some of these variables, such as advanced lower extremity capacity, depressive symptoms, and physical activity behavior, should be of particular interest for geriatric physical therapy due to their intervention potentials.

Self-rated health is associated with multiple variables from various ICF components representing an older persons' body, their personal and environmental context, and their roles in life. Self-rated health also reflects dimensions of health that may not be captured by more detailed scales. Therefore, self-rated health may be a valuable addition to the geriatric physical therapy context as it provides simple client-centered information on the complex and holistic sense of general health in older adults.

Residency in urban versus rural areas is an example of an environmental factor that should not be overlooked in studies on functioning and health in old age as it was independently related to both participation frequency and perceived participation restriction.

The ICF was useful as a conceptual framework for facilitating the research process and understanding of complex multidimensional phenomena such as participation and self-rated health. However, we also encountered the shortcomings of the ICF related to the lack of a clear definition of participation, the unclear approach regarding personal factors and the challenge to link physical activity, self-efficacy, and perceptions of one's own health to the framework, and finally the lack of standardized assessments developed with a theoretical base. Therefore we share concerns regarding the need to expedite further development of the ICF.

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