Multimodal Training Intervention

An Approach to Successful Aging

Janus Friðrik Guðlaugsson

Dissertation submitted
in partial fulfilment of a Ph.D.-degree

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UNIVERSITY OF ICELAND
SCHOOL OF EDUCATION

Fjölþætt heilsurækt

Leið að farsælli öldrun

Janus Friðrik Guðlaugsson

Fræðiritgerð lögð fram til að uppfylla kröfur um
Ph.D.-háskólagráðu
September 2014

Leiðbeinendur
Erlingur Jóhannsson
Sigurbjörn Árni Arngrímsson

Doktorsnefnd
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HÁSKÓLI ÍSLANDS
MENNTAVÍSINDASVIÐ

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ISBN (apply at http://www.landsbokasafn.is/)

Design: JFG & Háskólaprent ehf.

Printed in Iceland by Háskólaprent, Reykjavík 2014.

Ágrip

Inngangur

Í flestum löndum heims ná íbúar stöðugt hærri aldri og því er mikilvægt að rannsaka heilsu fólks á efri árum. Rannsóknir benda til þess að virkur lífsstíll og fjölbreytt þjálfun hafi margvíslegan heilsutengdan ávinning í för með sér auk þess sem þjálfunin getur dregið úr ýmsum áhættuþáttum sem tengjast aldri. Virkur lífsstíll er meðal annars fólginn í reglubundinni hreyfingu sem felur í sér loftháða þjálfun og styrktarþjálfun. Slík þjálfun hefur sannað gildi sitt fyrir hjarta-, æða-, lungna- og stoðkerfi. Af yfirlitsrannsóknum má ráða að það sé nánast sannað að þjálfun hafi jákvæð áhrif á líkamsþrek, hagnýta hreyfigetu, athafnir daglegs lífs (ADL) og heilsutengd lífsgæði, ekki síst þegar veikburða eldri einstaklingar eru annars vegar.

Gögn um daglega hreyfingu almennings gefa til kynna að rúmlega þriðj-ungur íbúa heims nái ekki einu sinni ráðlögðu lágmarki daglegrar hreyfingar. Þrátt fyrir mikla þekkingu á jákvæðum áhrifum af reglubundinni hreyfingu fer hreyfing minnkandi og árið 2009 var talið að hlutfall þeirra jarðarbúa sem væru óvirkir eða hreyfðu sig ekki sem neinu næmi væri um 17%.

Í rannsóknum kemur fram að 6–10% dauðsfalla tengist sjúkdómum sem megi rekja til hreyfingarleysis. Talið er að þessi tala sé jafnvel hærri, eða um 30% þegar um er að ræða tiltekna hjarta- og æðasjúkdóma tengda blóðþurrð. Árið 2007 var talið að koma mætti í veg fyrir um 5,5 milljónir dauðsfalla af völdum sjúkdóma, sem ekki eru smitandi, með því að fá kyrrsetufólk til að stunda hreyfingu. Hreyfingarleysi á heimsvísu hefur samt aukist þó að þekking á þjálfunaraðferðum sem leiða til bættrar heilsu hafi farið vaxandi. Þessu ástandi er líkt við heimsfaraldur því að það snertir ekki einungis heilsu fólks heldur eru afleiðingarnar einnig efnahagslegar, umhverfislegar og félagslegar.

Í nýlegri skýrslu frá bandarískum heilbrigðisyfirvöldum eru settar fram mikilvægar ábendingar tengdar heilsu 65 ára og eldri einstaklinga. Helstu þættir sem nefndir eru og stuðla að góðri heilsu eru reglubundin hreyfing, æskileg næring og að forðast tóbaksreykingar. Helstu þættir sem aftur á móti stofna heilsu eldri aldurshópa í hættu eru minnkandi hreyfing, lítil ávaxta- og grænmetisneysla, offita og tóbaksreykingar. Rannsóknarniðurstöður frá 2011 gáfu til kynna að um 33% einstaklinga, 65 ára og eldri, hreyfðu sig ekki, 73% borðuðu færri en fimm ávaxta- og grænmetisskammta á dag, 24% þeirra væru í offituflokki og 8% reyktu. Þessar niðurstöður sýna fram á mikilvægi þess að

koma á fót heilsutengdri íhlutun í samfélögum þjóða með það að markmiði að stemma stigu við áhættuþáttum tengdum heilsuleysi og um leið að auka markvissa hreyfingu og æskilega næringarinntöku meðal eldri aldurshópa.

Markmið þessarar doktorsritgerðar var að athuga hvaða áhrif sex mánaða íhlutun sem byggð var á sex mánaða fjölþættri hreyfingu og ráðleggingum um næringu og heilsu hefði á helstu útkomubreytur eins og daglega hreyfingu, hreyfigetu, styrk, þol, líkamssamsetningu og þætti tengda hjarta og æðasjúkdómum. Markmiðið var jafnframt að skoða áhrif íhlutunar til lengri tíma, eða sex og tólf mánuðum eftir að íhlutunartímabili lauk. Ennfremur var athugað hvort áhrif íhlutunar væru ólík meðal eldri karla og kvenna í rannsókninni og hvort hún hefði mismunandi áhrif á ólíka aldurshópa. Með alþjóðlegar ráðleggingar og sjálfbærni að leiðarljósi var einnig reynt að meta hvort sú aðferð og íhlutun sem beitt var gæti reynst gagnleg fyrir eldri einstaklinga til að viðhalda eða bæta eigin heilsu til lengri tíma.

Aðferðir

Snið rannsóknarinnar var víxlað þar sem þátttakendum (n=117) var skipt af handahófi í tvo hópa, fyrri þjálfunarhóp (n=56) og seinni þjálfunarhóp (n=61). Að loknum grunnmælingum og síðan skiptingu í hópa stóð þjálfunar- og rannsóknartími yfir á þremur sex mánaða tímabilum. Fyrri þjálfunarhópur tók þátt í sex mánaða fjölþættri þjálfun (6-MTI) auk þess sem hann fékk næringar- og heilsuráðgjöf en seinni þjálfunarhópurinn var viðmiðunarhópur í sex mánuði. Eftir 6-MTI hjá fyrri þjálfunarhópi og biðtíma hjá seinni þjálfunarhópi voru grunnmælingar endurteknar. Þegar þessum mælingum var lokið lauk afskiptum af fyrri þjálfunarhópi en seinni þjálfunarhópur tók þátt í sambærilegri 6-MTI og fyrri þjálfunarhópur. Eftir seinna 6-MTI-tímabilið voru mælingar aftur endurteknar hjá báðum hópum. Þar með lauk afskiptum rannsakenda af seinni þjálfunarhópi. Sex mánuðum eftir að seinni þjálfunarhópur lauk sinni þjálfun voru mælingar endurteknar í fjórða sinn á báðum hópum. Að því loknu lauk rannsókninni formlega.

Þátttakendur í þessari rannsókn voru heilbrigðir einstaklingar á aldrinum 71–90 ára sem höfðu tekið þátt í Öldrunarrannsókn Hjartaverndar og staðist ákveðnar grunnmælingar sem gengið var út frá og tengdust heilsufarsstöðu þeirra og niðurstöðum í SPPB-hreyfifærniprófi. Af þeim 325 einstaklingum sem höfðu náð 70 ára aldri þáðu 96 þátttöku. Af þessum fjölda uppfylltu 92 kröfur um þátttöku auk þess sem mökum þátttakenda var boðin þátttaka og þáðu 25 makar boðið. Helstu ástæður þess að hafna boði voru of langur og bindandi rannsóknartími, áhugaleysi eða veikindi.

Íhlutun fólst í sex mánaða fjölþættri þjálfun með áherslu á daglega þolþjálfun og styrktarþjálfun tvisvar í viku. Þessu til stuðnings var ráðgjöf um næringu og fjórir fyrirlestrar um heilsutengda þætti. Þolþjálfun var einstaklingsmiðuð og fólgin í daglegri göngu á þjálfunartíma, að meðaltali um 30 mínútur á dag. Styrktarþjálfun fór fram í líkams- og heilsuræktarstöð tvisvar sinnum í viku, var einnig einstaklingsmiðuð og innihélt 12 æfingar fyrir helstu vöðvahópa líkamans.

Helstu mælingar á öllum tímapunktum voru dagleg hreyfing mæld með hreyfimæli (e. *actigraph accelerometers*) og stöðluðum spurningalista. Líkamsþyngdarstuðull (LÞS) var mældur með því að deila hæð í öðru veldi (m^2) í líkamsþyngd (kg), SPPB-hreyfigetuprófið var framkvæmt og hreyfijafnvægi mælt með átta feta gönguprófi. Kraftur var mældur í sérhönnuðu kraftmælingatæki (e. *adjustable dynamometer chair*) og þol mælt með sex mínútna gönguprófi (6MW). Heilsutengd lífsgæði voru mæld með stöðluðum spurningalista. Holdafar var mælt með DXA-skanna í Hjartavernd í Kópavogi auk þess sem þar fóru allar blóðmælingar fram við kjöraðstæður.

Niðurstöður

Mælingar í upphafi rannsóknar, bæði með hreyfimæli og spurningalista, sýndu að dagleg hreyfing meirihluta þátttakenda var lítið brot af því sem er ráðlagt. Um 60% þátttakenda hreyfðu sig að jafnaði í 15 mínútur eða minna í hvert skipti sem þeir hreyfðu sig, sem er nokkuð undir alþjóðlegum ráðleggingum. Um 70% þátttakenda stunduðu göngur þrjá daga eða sjaldnar í hverri viku og um 10% þátttakenda stunduðu styrktarþjálfun. Sex mánuðum eftir 6-MTI gengu um 35% þátttakenda í 16–30 mínútur í hvert skipti sem þeir stunduðu hreyfingu og sama hlutfall gekk í lengri tíma en 30 mínútur. Göngudagar í hverri viku á þessum tímapunkti voru fjórir eða fleiri hjá rúmlega 50% þátttakenda og um 40% þátttakenda sögðust ganga tvisvar til þrisvar í viku. Styrktarþjálfunardagar hjá þátttakendum á þessum tímapunkti voru tveir eða fleiri hjá um 40% þátttakenda. Tæplega 60% stunduðu enga styrktarþjálfun á þessum tímapunkti. Einu ári eftir 6-MTI var staðan mjög svipuð og sex mánuðum á undan hjá fyrri þjálfunarhópi.

Niðurstöður mælinga á hreyfigetu þátttakenda, hvort sem um er að ræða hópinn í heild, eldri karla eða konur sérstaklega eða mismunandi aldurshópa, sýndu verulega bætingu á útkomubreytum. Þetta á bæði við um heildarniðurstöður í SPPB-hreyfigetuprófi og í einstökum þáttum þess fyrir utan jafnvægi. Þar var getan mjög góð fyrir og því var rými til bætingar lítið. Sama á við um átta feta hreyfijafnvægisprófið (e. *8-foot up-and-go test*) en þar urðu framfarir miklar. Í báðum þessum prófum héldust jákvæðu breytingar í að minnsta kosti eitt ár hjá fyrri þjálfunarhópi eftir að 6-MTI lauk og í að minnsta kosti sex mánuði hjá seinni þjálfunarhópi.

Að lokinni íhlutun kom í ljós aukning á styrk handa og fóta og einnig á 6MW-þolprófi. Hinar jákvæðu breytingar héldust í 6MW þegar mælingar voru endurteknar sex og tólf mánuðum eftir að þjálfun lauk en styrkurinn færðist nær niðurstöðum upphafsmælinga á þessum tímapunktum án þess þó að fara niður fyrir upphaflegu gildin.

Líkamssamsetning, svo sem þyngd, LÞS og fitumassi, batnaði við lok þjálfunartímabils. Þessar jákvæðu breytingar héldust ekki í öllum mælingum þegar þær voru skoðaðar sex mánuðum eftir íhlutunartíma. Jákvæðar breytingar á vöðvamassa áttu sér stað hjá fyrri þjálfunarhópi að lokinni 6-MTI en hélst óbreytt hjá seinni þjálfunarhópi. Við eftirfylgnimælingar voru jákvæðu áhrifin horfin.

Varðandi mælingar á áhættuþáttum hjarta og æðasjúkóma, þá komu fram jákvæðar breytingar á ummáli á kvið, blóðþrýstingi, góðu kólesteróli (HDL), glúkósa og þríglýseríðum að lokinni sex mánaða íhlutun. Þessar breytingar héldust flestar sex mánuðum eftir að íhlutunartíma lauk þar sem meðal annars blóðþrýstingur hélt áfram að lækka.

Ályktanir

Rannsóknin sýnir mikilvægi þess að fylgjast með stöðu eldri aldurshópa á Íslandi. Hún sýnir einnig fram á ávinning af fjölþættri þjálfunaráætlun sem meðal annars fæli í sér daglega hreyfingu í formi þolþjálfunar og styrktarþjálfun tvisvar í viku. Niðurstöður sýna einnig greinilega að eldri aldurshópar geta haft margvíslegan ávinning af markvissri líkams- og heilsurækt ef tíðni æfinga, tímalengd þeirra og ákefð er vel skipulögð. Gera má ráð fyrir að þjálfun af þeim toga sem skipulögð var í rannsókninni geti komið í veg fyrir ótímabæra skerðingu á hreyfigetu, unnið gegn áhættuþáttum hjarta- og æðasjúkdóma og viðhaldið heilsutengdum lífsgæðum eldra fólks. Álykta má að þjálfun af þessum toga fyrir eldri aldurshópa ætti að vera þáttur í hefðbundinni heilsugæslu eldra fólks. Niðurstöður þessarar doktorsritgerðar undirstrika jafnframt þörfina á áframhaldandi þróun íhlutunaraðgerða fyrir eldri borgara svo þeir geti sinnt athöfnum daglegs lífs eins lengi og kostur er án utanaðkomandi aðstoðar.

Lykilorð

Hreyfigeta, styrkur, þol, hreyfing, eldri aldurshópar, íhlutunarrannsókn, áhættuþættir hjarta- og æðasjúkdómar.

Abstract

Introduction

Research has demonstrated that the worldwide population is aging. It has also confirmed that physical activity (PA) can play a meaningful role in decreasing impairment characteristics of old age. Adopting a healthier and more active lifestyle that includes aerobic and resistance exercises has been demonstrated to reform cardiovascular, respiratory, and musculoskeletal parameters in older adults. Recent review articles have also concluded that there is strong evidence for the positive effects of exercise training on physical fitness, functional performance, activity of daily living and quality of life, even in frail older individuals.

Available data about people's daily activity indicate that about 30% of the world's population is not meeting the minimum recommendation for PA, and in 2009, the global prevalence of inactivity was estimated at 17%. Despite promising positive trends in leisure-time PA in many countries, incidental PA patterns and activity connected to transportation or labor, the prevalence of PA is decreasing.

Despite it being known that PA leads to positive results, inactivity among populations is still increasing. Research has established that 6–10% of all deaths from non-communicable diseases worldwide can be attributed to physical inactivity. This percentage is even higher for specific diseases, such as ischaemic heart disease, being about 30%. In 2007, about 5.5 million deaths globally from non-communicable diseases could theoretically have been prevented if people who were inactive had instead been sufficiently active. Despite greater knowledge of training methods that result in better physical health for all age groups, inactivity has increased and the issue is described as a pandemic, with far-reaching health, economic, environmental, and social consequences.

In a relatively new statement from aging and health authorities in the United States, the National Report Card for the State of Aging and Health in America, 15 key indicators related to the health of adults aged 65 and older are defined. However, key indicators for health risk behaviours for older adults are lack of activity, eating fewer than five portions of fruit and vegetables per day, obesity, and current smoking. Results from a recently published study showed that 33% of older adults engaged in no leisure time activity, 73% were eating fewer than five portions of fruit and vegetables

daily, 24% were obese, and 8% were currently smoking. This underlines the importance of establishing specific health intervention efforts in communities in different countries in order to address preventable health risks among older adults and at the same time encourage systematic PA and preferable nutrition among older adults.

Aims

The aim of this dissertation was to examine the effects of a 6-month multimodal training intervention (6-MTI) and nutrition and health counseling on different variables, such as functional performance, strength, endurance, body composition and metabolic risk factors. The aim was also to evaluate at 6- and 12-month follow-ups the effects and sustainability of a 6-MTI. Furthermore, the aim was to investigate the effects on the different sexes and to see whether they were different between older males and females. Another goal was to examine the 6-MTI effect and long-term effects on participants, who were divided into three different age groups. Finally, the aim was to evaluate whether the applied 6-MTI design and methodology could form a sustainable strategy for developing and maintaining the health of older age groups with regard to international recommendations.

Methods

This study was a randomized controlled, cross-over design. After enrollment and baseline assessment the participants (n=117) were randomized into an immediate training intervention group (n=56) and a delayed intervention group (n=61). The trial was conducted in three 6-month phases after the baseline assessment. The immediate intervention group participated in a 6-MTI, while the delayed intervention group served as a control group. At this time point, after the baseline measurements were repeated, the crossover took place. The delayed intervention group received comparable training intervention for 6 months as the immediate intervention group received before, which from that time-point did not receive any further intervention from the research staff. After the second 6-MTI, the baseline measurements were repeated in both groups. The delayed intervention group did not receive any further intervention. An additional 6-month follow-up was done and the measurements were repeated for the fourth time. At this time point the research was formally closed.

The participants were healthy older individuals, 71–90 years old, selected from the population-based Age, Gene/Environment Susceptibility – (AGES) Reykjavik Study that had been screened depending on their health and physical performance. Ninety-two of the 325 older individuals (>70 years), along with 25 spouses, accepted the invitation. The main reasons for dropping out were that the study was conducted over too long and binding period, participants showed a lack of interest or participants suffered illness.

The intervention consisted of a 6-month multimodal training with an emphasis on daily endurance training (ET) and twice-a-week resistance training (RT). This was supported by three lectures on nutrition and four on health-related topics. The ET consisted of daily walking throughout the intervention phase, and the average duration per day was estimated at around 30 minutes. The RT took place twice-a-week in a fitness center, was individualized and consisted of 12 exercises for all major muscle groups.

The measurements were performed at four time-points, at baseline and then additionally three at the end of each 6-month period. The primary measurements were: daily activity assessed with Actigraph accelerometers and a standardized questionnaire. Body mass index (BMI) was calculated as body mass (kg) divided by height squared (m2). Physical performance was measured with the SPPB-test and mobility and balance was measured by the 8-foot up-and-go test. Maximal isometric muscle strength of the thigh and hand was measured in an adjustable dynamometer chair and endurance performance was measured using the 6-minute walk test (6MW). Quality of life was measured with standardized questionnaire. Whole-body composition was measured using Dual energy X-ray absorptiometry, iDXA software, and blood analysis was done at the Icelandic Heart Association using standard protocols.

Main results

The main results concerning PA at baseline showed that most of the participants did little PA according to international guidelines. About 60% was physically active for 15 minutes or less each time they walked, which is far from the international recommendation. Seventy percent of the participants walked three days or less each week and about 10% participated in RT. Six months after the 6-MTI about 35% walked 16 to 30 minutes every time they walked, and 35% walked longer than 30 minutes when they walked. About 50% had four or more walking days in every week at this time-point and 40% said they walked 2–3 days a week. About 40% of the participants had two or more resistance-training days 6 months after the 6-MTI, but about 60% did not do any kind of RT. One year after the intervention the status was similar, both in endurance and RT participation.

The results from physical performance tests for the whole group, male or female separated or different age groups, showed remarkable changes. This concerns the main results in the SPPB-test except balance which had a ceiling effect. The results from the dynamic balance 8-foot up-and-go test were similar. In both these tests the results were maintained for at least one year after the 6-MTI.

An improvement after the 6-MTI was seen in the strength tests for hand and thigh and also in the 6MW endurance test. The positive changes were maintained in the endurance test at 6 and 12 months follow-up but the strength went back to baseline.

Changes in body composition, such as weight, BMI and fat-mass were for the better at the end of the 6-MTI. These changes were not all maintained in the follow-up phases. An increase was seen in total lean mass by the immediate intervention group, but in their control phase, 6 months after the 6-MTI, the total lean mass decreased back to baseline and the total fat mass increased at the same time.

A decrease was seen in the cardiometabolic risk factors, waist circumference, systolic and diastolic blood pressure, after the 6-MTI by the immediate intervention group. The same results were seen for the delayed intervention group in their intervention period. Most of these changes were maintained at the 6-month follow-up, where the blood pressure kept on decreasing.

Conclusions

The study shows how important it is to pay attention to the health status of older adults. The research also points to the benefit of a multimodal training intervention that consists of daily PA in the form of walking and RT twice a week. The research outcome clearly shows that older adults can obtain multiple benefits by participating in systematic physical training where frequency, duration and intensity are well organized. One can assume that training of this sort, as organized in the study, can prevent premature impairment of mobility, work against cardiometabolic risk factors and maintain the quality of life of older adults. One can conclude that training of this sort for older age groups should be a part of regular healthcare for seniors. The results of this thesis emphasize the need for continued development of interventions for this age group to support older individuals in keeping up their activity of daily living as long as possible.

Keywords

Physical performance, strength, endurance, physical activity, older adults, intervention study, cardiometabolic risk factors

Acknowledgements

The research project described, analyzed and discussed in this thesis was carried out at the Centre for Sport and Health Sciences at the University of Iceland, Reykjavik, in collaboration with the School of Education and Hjartavernd (the Icelandic Heart Association) between 2007 and 2014.

A number of people have been involved in this dissertation and throughout the long doctoral work. I would like to thank them all for their teamwork, cooperation, support and patience. Without external help, understanding, guidance or motivation it would have been difficult to accomplish this task. Special thanks go to supervisors, colleagues, friends and family but also to the participants in the research. Without their participation, understanding and help I would not have come so far today.

First of all I would like to thank my primary supervisor, Professor Erlingur Jóhannsson at the Center for Sport and Health Sciences, the University of Iceland, for his advice, patience and encouragement during the last few years. With his efficiency and diligence this project came to fruition. Thanks also go to my other mentor, Professor Sigurbjörn Árni Arngrímsson, at the Centre for Sport and Health Sciences, for his invaluable recommendations, his guidance in writing, his sharp comments and informative replies to my enquiries. Thanks to associate professor Anna Sigríður Ólafsdóttir, at the Centre for Sport and Health Sciences, for her help and approach concerning the nutrition part of the study.

I would also like to give the Ph.D. committee thanks for their cooperation and help, Professor Vilmundur Guðnason for his resourcefulness and inspiration and Professor Pálmi Jónsson for his generosity and guidance in writing the articles. Dr Thor Aspelund statistician, associate professor in the Department of Medicine, Center of Public Health, deserves my gratitude for his company, backup and help regarding statistical analysis.

Thanks go to all the members of the research team who I have worked with during the design phase, measurements or intervention. These were the graduate master´s students; Elísabet Kristjánsdóttir, Guðrún Valgerður Ásgeirsdóttir, Sandra Jónasdóttir, Sigurður Örn Gunnarsson and Steinunn Leifsdóttir. I would also like to thank the other students who completed their master’s degrees in connection with this study. They were Steinunn Arnars Ólafsdóttir, Vaka Rögnvaldsdóttir, Aníta Ýr Eyþórsdóttir and Ragnheiður

Júníusdóttir. Their master's degrees had their origins in the research together with several graduate students who also finished their master's degrees via this research. Thanks also go to Samuel Örn Erlingsson for his BSc project that covered older adults and his exclusive CD, A Quality of Life on Home Stretch (*Lífsgæði á lokaspretti*).

I would like to thank my colleagues Dr Hannes Hrafnkelsson and Dr Kristján Þór Magnússon for their valuable time in the last few years. Thanks to Ingi Þór Einarsson for discussing different topics around the study, Sturla Halldórsson at the bookshop for printing out all the different forms that was used, as diaries, questionnaires and measurement forms. Thanks also go to Margét J Haglínsdóttir and Birgir Bjarnason for their help at the Icelandic Heart Association, the personnel at Altis in Hafnarfjörður for helping us with the Polar heart rate monitors.

Special thanks go to all the older participants who participated in the research, for their contribution and participation, their efficiency and patience in carrying out a long intervention period, control time and all the repeated measurements we went through. Thanks to you all.

I would like to express my gratitude to the owners of the fitness centre World Class Laugar for their generosity in allowing us to train free of charge for one year. I would also like to give thanks to the personnel at the Icelandic Heart Association in Kópavogur for their assistance and support: Kristín Siggeirsdóttir for her help on the strength measurements and reading through the first article, Sigurður Sigurðsson and Díana Óskarsdóttir for the cooperation on DXA measurements, Guðný Eiríksdóttir for her help around the sample, Jóhanna Eyrún and partners who were in charge of the hemodialysis, and the receptionists who always met me with a smile as did other personnel at the Icelandic Heart Association when they were asked for support.

Thanks go to Professor Tammy Harris and the research team at The National Institute of Aging in Bethesda, USA for their help and memorable months in 2010. Special thanks go also to Paolo Caserotti for sharing his knowledge and experience in relation to older adults, Sebastian Vidal and Caroline Phillip for transferring the material between different programs, Ann-Mary for her discussion and thoughts, Björn Heine Strand for his help on the power calculations, Dane van Domelen for his cooperation on the accelerometer measurements, Patel Kushang and Jack Guralnik for a memorable talk about the Short Physical Performance Battery test.

Research projects like this would not be possible without financial support. I would like to thank undermentioned institutions, organizations and companies for their support:

- The Icelandic Center for Research – RANNÍS (Rannsóknamiðstöð Íslands – RANNÍS)
- The Fitness Center World Class Laugar (World Class Laugar heilsurækt)
- The Sport Fund at the Ministry of Education, Science and Culture (Íþróttasjóður)
- The Capital Area Commune Association (Samband sveitarfélga á höfuðborgarsvæðinu)
- The Football Association of Iceland (Knattspyrnusamband Íslands)
- The Physiotherapy Máttur in Árborg (Máttur Sjúkraþjálfun, Selfossi)
- The Commune Árborg (Sveitarfélagið Árborg)
- The General and Transport Workers' Union – Hlíf (Verkamannafélagið Hlíf, Hafnarfirði)
- The Older Fishermen's Home Hrafnista – DAS (Hrafnista – DAS)
- The Kiwanis Club Eldborg in Hafnarfjörður (Kiwanisklúbburinn Eldborg, Hafnarfirði)
- The Oddfellow Order in Iceland (Oddfellowreglan á Íslandi)
- The Directorate of Health in Iceland (Embætti landlæknis)
- The School and Leisure Region Reykjavik (Íþrótta- og tómstundasvið Reykjavíkurborgar).

Special thanks go to my family and all my friends for their support and encouragement over the past few years. Particular thanks go to my two sons, Andri and Daði, for their help on calculations from my database and my daughter Lára for her help and encouragement. Special thanks go to my wife Sigrún for her understanding of "why the old guy and grandpa is still learning".

This work is dedicated to all of the older individuals from the study who have passed away, and to my father and father-in-law who have both passed away from diseases and lack of mobility in later life. This work is also dedicated to my brother who passed away in the prime of his life due to illness.

Reykjavik, April 2014

Janus Guðlaugsson

Contents

List of abbreviations

1RM	One repetition maximum
6-MTI	6-month multimodal training intervention
6MW	6-minute walking test
ACSM	American College of Sports Medicine
ATP	Adenosine triphosphate
BMI	Body mass index (kg/nm2)
BMR	Basel metabolic rate
BP	Blood pressure
CI	Confidence interval
cpm	Count per minutes
CRP	C-reactive protein
CVD	Cardiovascular disease
DBP	Diastolic blood pressure
DXA	Dual energy x-ray absorptiometry
ET	Endurance training
FFM	Fat-free mass
FM	Fat mass
HR	Heart rate
HRR	Heart rate reserve, resting heart rate
IAAT	Intra-abdominal adipose tissue
IQL	Icelandic Quality of life
LBM	Lean body mass
NC	Nutrition counseling
PA	Physical activity
RCT	Randomized controlled trial
ROM	Range of motion
RT	Resistance training
SAT	Subcutaneous adipose tissue
SBP	Systolic blood pressure
SD	Standard deviation
SPPB	Short physical performance battery test
TC	Total cholesterol
TG	Triglycerides
VO2max	Maximal aerobic capacity
WHO	World Health Organization

List of figures

List of tables

List of original papers

This thesis is based on the following original publications, which are referred to in the text by their Roman numerals (I-III [as needed]):

I. Gudlaugsson. J., Gudnason., V., Aspelund, T., Siggeirsdottir, K., Olafsdottir, A. S., Jonsson, P. V., Arngrimsson, S. A., Harris, T. B. & Johannsson, E. (2012). Effects of a 6-month multimodal training intervention on retention of functional fitness in older adults: A randomized-controlled cross-over design. Int J Behav Nutr Phys Act, 9, 107.

II. Gudlaugsson, J., Gudnason, V., Aspelund, T., Olafsdóttir, A.S., Jonsson, P.V., Arngrímsson, S. A. & Johannsson, E. (2013). Effects of exercise training and nutrition counseling on body composition and cardiometabolic factors in old individuals. European Geriatric Medicine, 4(6), 431-437.

III Gudlaugsson, J., Aspelund, T., Gudnason, V., Olafsdottir, A. S., Jonsson, P. V., Arngrimsson, S. A., & Johannsson, E. (2013). The effects of 6 months' multimodal training on functional performance, strength, endurance, and body mass index of older individuals. Are the benefits of training similar among women and men? [Article in Icelandic]. *Laeknabladid, 99*(7-8), 331-337.

Declaration of contribution

Janus contributed to the idea, design and practical implementation of the study during the measurements in the spring of 2008. Janus was responsible for the plan of all of the measurements from the study. He was also responsible for the PA and physical performance measurements throughout the study as well as significant participation in all other measurements conducted at the Heart Association of Iceland. Janus contributed to the design of the 6-month intervention and the synthesis of theoretical work which the intervention was built on. He both conducted and contributed to the talks given to study participants, teachers, health instructors and principals during the study period. Janus was responsible for the statistical analysis and contributed most to the writing of Papers I, II and III.

1 Introduction

1.1 General perspective

The proportion of older persons in the population is increasing in all highly industrialized countries of the world. As an example, an increase of 50% in the number of 80–90-yerars-old is expected to take place between 1995 and 2050 in England (Biley, 2002). Recent medical advances and improvements in hygiene and food supply have led to Japan having the longest life expectancy in the world, where the elderly population has increased fourfold from 5.7% in 1960 to 23.1% in 2010 (Arai et al., 2012). This change in Japan has occurred at the fastest rate in the world. In addition, the percentage of the very elderly (aged 75 years and older), comprising more frail people, exceeded 10% of the nation's population in 2008. In such situation, many elderly Japanese wish to spend their later years healthy, and wish to achieve great accomplishments in their lives. To achieve that, rather than considering an aging population as a negative social phenomenon, societies have to create conditions where elderly people can enjoy a healthy, prosperous life through social participation and contribution (Arai et al., 2012).

The same trend can be seen in Iceland where the nation is on its way to becoming an aging society like most western countries. In 1990, Icelanders 65 years and older constituted about 10% of the population. Today, the total population is approximately 322,000; 13% are 65 years and older, 19.400 males and 22.200 females. By the year 2060, the proportion of older people will increase immensely so that 25% of the nation will be over 65 years of age (Statistics Iceland, 2014).

With an aging population in the late 1990s, disability and associated morbidity have increased (Fries, Bruce, & Chakravarty, 2011; Guralnik, Land, Blazer, Fillenbaum, & Branch, 1993). The reduction in infectious diseases earlier in the last century has been subsequently offset by increases in the prevalence of chronic diseases (e.g., cardiovascular disease and cancer) that have become the dominant causes of disability and mortality in the elderly (Hoffman, Rice, & Sung, 1996). Chronic non-communicable diseases are the cause of 86% of all deaths in the EU and 65% of deaths worldwide (WHO, 2006a). Despite only a slight increase in healthy life expectancy in the last 15 years in Iceland (male: 1.09 years and female 1.08 years) (Statistics Iceland, 2014), it is to be expected that the number of elderly persons with functional limitations and disability will further increase, due to the growing number of very old individuals (WHO, 2002).

Health promotion interventions in primary healthcare settings could be highly effective, as many older adults use healthcare services regularly and physicians represent key social influences (Dishman, 1994). Contacts between older adult and a physician offer opportunities for primary prevention, such as the promotion of an active lifestyle (Dishman, 1994; van der Bij, Laurant, & Wensing, 2002). Changes in healthcare delivery systems and physicians' attitudes toward the delivery of preventive services may be necessary so that older adults receive appropriate information and counseling related to physical activity (PA) (van der Bij et al., 2002). Results from a study that examined changes in PA and short-term changes in health care charges showed that adults who initiated a physically active lifestyle had significantly declining health care charges, relative to those who were consistently inactive. These cost savings may justify investments in effective interventions to increase PA in older adults (Martinson, Crain, Pronk, O'Connor, & Maciosek, 2003). A recent systematic review has summarized evidence on the financial return of worksite health promotion programs aimed at improving nutrition and/or increasing PA generated financial savings in terms of reduced absenteeism costs, medical costs or both. On average, the financial return in terms of absenteeism benefits, medical benefits or both were positive during the first years after implementation (van Dongen et al., 2011). There is a growing interest in workplace disease prevention and wellness program to improve health and lower costs. Although further exploration of the mechanisms at work and broader applicability is needed, this return on investment suggests that the wider adoption of such programs could prove beneficial for budgets and productivity as well as health outcomes (Baicker, Cutler, & Song, 2010).

Although the health benefits of PA are well-established, there are some barriers to engaging in PA among older people. The majority of adults do not undertake regular PA and they are less likely than younger adults to meet public health goals for sustained activity (Ory, Jordan, & Bazzarre, 2002). They may assume that the health promotion messages about exercise are aimed at younger adults or that limitations in physical function prevent them from participating in exercise. Thus, helping sedentary older people to start and adhere to regular exercise is likely to pose particular challenges. Given that many of the barriers to engaging in PA among older people are attitudinal, it is essential to take account of the psychological components, such as confidence, perceived exercise enjoyment and satisfaction in the development of PA intervention programs designed for this age group (Ory et al., 2002).

One of the most widely applied theories in predicting health behavior and facilitation behavioral modification is the theory of self-efficacy, a central concept of Bandura's social cognitive theory (Bandura, A., 1986, Social foundations of thought and action: A social cognitive theory) (Lee, Arthur, & Avis, 2008). In relation to various health promotion behaviors, the concept of self-efficacy has been incorporated into several conceptual models of health behavior, such as the theory of planned behavior (de Vries, Dijkstra, & Kuhlman, 1988; McCaul, Sandgren, O'Neill, & Hinsz, 1993) and the health belief model (Rosenstock, Strecher, & Becker, 1988).

Although the loss of independency occurs at many levels, mobility-related impairment, especially in the lower extremity, is likely to be the most critical factor (Guralnik, Ferrucci, Simonsick, Salive, & Wallace, 1995; Ross, Schmidt, & Ball, 2013). Poor function of the lower limbs has been shown to be predictive of future hospitalization and disability in non-disabled individuals (Friedman et al., 2008; Guralnik et al., 1995; Penninx et al., 2000). This condition has been defined as the preclinical state of disability (Ploutz-Snyder, Manini, Ploutz-Snyder, & Wolf, 2002) in currently healthy subjects and described as the reduced physiological reserve capacity of the neuromuscular system (Friedman, Kern, & Reynolds, 2010; Penninx et al., 2000; Rantanen, 2003; Vandervoort, 2002).

Thus, independent older individuals may still be able to carry out everyday motor tasks successfully, although unable to conquer them in a safe manner (Rantanen, 2003). More importantly, these older individuals are unable to respond with a sufficient proper motor response during an unexpected situation such as a fall, due to a reduced physiological reserve (Dutta, 1997; Rantanen, 2003). From this point of view it is essential to highlight that many older individuals consider the capacity to carry out activities of daily living (i.e., functional independence) to be of greater concern than prevention of disease (Paterson, Govindasamy, Vidmar, Cunningham, & Koval, 2004; Warburton, Gledhill, & Quinney, 2001; Warburton, Glendhill, & Quinney, 2001). Moreover, the health related quality of life and life expectancy of individuals who live in a dependent state is greatly reduced (Paterson & Warburton, 2010).

Today, plenty of data show that even the weakest members of the older population can favorably respond to exercise. Therefore, PA and fitness remain essential in older age with regard to maintaining a functional and independent lifestyle for activities of daily living (ADL) (Chodzko-Zajko et al., 2009). Understanding the role of PA and fitness in altering aging-related changes in health and function has important public health implications, especially for meeting the needs of the ever-growing population of older adults (Chodzko-Zajko et al., 2009; DiPietro, 2001).

1.2 Aging and benefits of regular physical activity

PA is any bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure (Bouchard, Blair, & Haskell, 2012). Under this general definition, leisure-time PA, exercise, sport, transportation, occupational work and chores can be categorized. Exercise, a subset of PA, is PA that is planned, structured, repetitive and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective (Garber et al., 2011). The goals of an exercise program are different for elderly adults. For many young adults, exercise goals are to reach maximum or near-maximum capacity in many or all of their systems. Exercises are planned to produce maximum or competitive endurance, muscular strength and power, flexibility, and agility. The goals for old adults, as recommended by the American College of Sport Medicine (ACSM) Position Stand on Exercise and PA, are focused on health and maintenance of function (Garber et al., 2011). The same emphases are contained in the first comprehensive guidelines on PA ever to be issued by the US government, the 2008 Physical Activity Guidelines for Americans (Cunningham, Carroll, Carlson, & Fulton, 2013).

The effects of aging on PA patterns are dramatic, with more than 50% of those 65 to 74 years old and almost 66% of those over the age of 75 years reporting no leisure-time PA (Services, 1998). In recent data, PA levels for 15 years and older from 122 countries were described (Hallal et al., 2012). Inactivity rises with age where about 31% of adults are physically inactive and the inactivity will increase in high-income countries (Hallal et al., 2012). Sex differences in PA levels will arise during childhood and persist throughout the life span. On average, males are more physically active than females and tend to engage in more vigorous physical activities (Talbot, Metter, & Fleg, 2000).

Aging is characterized by loss of function and prevalence of chronic diseases, and older adults are among the most sedentary (physically inactive) segment of society (Paterson & Warburton, 2010). It is therefore important to increase the overall level of activity of an inactive person. Walking is therefore a very attractive option for older adults because it has cardiovascular and neuromuscular benefits and may also have a positive effect on the bone-health (Spirduso, Francis, & MacRae, 2005).

The main findings in a recent study of daily PA patterns and sedentary behavior in older Icelandic adults were that they spent on average 74.5% of their non-sleeping time as sedentary and 21.3% as low-light activity (Arnardottir et al., 2013). These results indicate that this age group has a very low activity level and most of the older adults fail to meet general recommendations for PA (Nelson et al., 2007). Since the publication of the first edition of the American College of Sports Medicine (ACSM) Position Stand, "Exercise and Physical Activity for Older Adults", a significant amount of new evidence has accumulated regarding the benefits of regular exercise training and PA for older adults (Arai et al., 2012; Chodzko-Zajko et al., 2009; Ross et al., 2013). In addition to evidence regarding the importance of exercise training and PA for healthy older adults, there is now a growing body of knowledge supporting the prescription of exercise training and physical activity for older adults with chronic diseases and disabilities (Cress et al., 2005; Nelson et al., 2007; Paterson & Warburton, 2010).

The revision of the ACSM position Stand "Exercise and Physical Activity for Older Adults" updates and expands the earlier Position Stand and provides an overview of issues critical to exercise training and PA in older adults. The Position Stand is divided into three sections, where the first one briefly reviews some of the structural and functional changes that characterize normal human aging, and the second one considers the extent to which exercise training and/or PA can influence the aging process through its impact on physiological function and through its impact on the development and progression of chronic disease and disabling conditions. The third section summarizes the benefits of both long-term exercise training and PA and shorter-duration exercise training programs on health and functional capacity (Chodzko-Zajko et al., 2009).

1.3 Endurance training

Endurance is the ability to resist fatigue, which includes muscular endurance and cardiorespiratory endurance. Aerobic training, or cardiorespiratory endurance training (ET), for example, improves central and peripheral blood flow and enhances the capacity of the muscle fibers to generate greater amounts of adenosine triphosphate (ATP) (Spina, Turner, & Ehsani, 1997). Supervised ET programs of optimal intensity ($\geq$ 60% of pre-training VO_{2max}), three days a week or more, for 16 weeks or more can significantly increase VO_{2max} in healthy middle-aged and older adults (Chodzko-Zajko et al., 2009). Further improvements in VO_{2max} are typically observed with longer training periods or from 20 to 30 weeks but the training intensities are not necessarily higher than >70% of VO_{2max} (Huang, Gibson, Tran, & Osness, 2005). In healthy subjects older than 75 years of age, ET has also shown significant increases in VO_{2max}, but the magnitude of improvement was significantly less (Evans, 2000; Malbut, Dinan, & Young, 2002). In the literature there seems to be a sex difference in the underlying mechanism of adaptation, where older men display increases in maximal cardiac output and systemic arteriovenous O_2 difference, whereas older women rely almost exclusively on widening the systemic arteriovenous O_2 difference (Spina et al., 1997).

The effects of ET on metabolic factors, independent of dietary changes, can develop multiple changes that enrich the body's ability to maintain glycemic control at rest (Hakkinen et al., 1998; Sillanpaa, Hakkinen, Punnonen, Hakkinen, & Laaksonen, 2009) and to clear atherogenic lipids (triglycerides) from the circulation after a meal (Katsanos, 2006). Healthy men and women in their seventies seem to retain the capacity to reset the cellular processes that enable these concerned training effects. However, the impact of ET on metabolic control measured at the whole body level and the residual metabolic effects after exercise, throughout the day, may depend on the management of the training intensity. For example, although both moderate (Short et al., 2003) and high-intensity (Cox, Cortright, Dohm, & Houmard, 1999) ET are shown to increase glucose transporter content in the muscles of older humans, it is the higher-intensity endurance programs that may result in greater improvement in whole-body insulin action (DiPietro, Dziura, Yeckel, & Neufer, 2006).

Three months or more of moderate-intensity, where the exercise is about 60% of VO_{2max}, induce several cardiovascular adaptions in healthy older adults which are obvious at rest and in response to acute dynamic exercise. In a pronouncement, Exercise and Physical Activity for Older Adults (Chodzko-Zajko et al., 2009), the most consistently reported adaptations are reported in four keystones: a) A lower heart rate at rest (Huang, Shi, Davis-Brezette, & Osness, 2005) and submaximal exercise workload (Hagberg et al., 1989), b) smaller rises in systolic, diastolic, and mean blood pressures during submaximal exercise (Seals, Hagberg, Hurley, Ehsani, & Holloszy, 1984), c) improvements in the vasodilator and O_2 uptake capacities of the trained muscle groups (Jubrias, Esselman, Price, Cress, & Conley, 2001; Martin, Kohrt, Malley, Korte, & Stoltz, 1990; Wray, Uberoi, Lawrenson, & Richardson, 2006) and d) numerous cardio protective effects, including reductions in atherogenic risk factors (reduced triglyceride and increased HDL concentrations), reductions in large elastic artery stiffness (Tanaka et al., 2000), improved endothelial (DeSouza et al., 2000) and baroreflex function (Okazaki et al., 2005), and increased vagal tone (Okazaki et al., 2005).

In studies involving body composition, overweight older participants have generally reduced their total body fat after moderate-intensity ET ($\geq$ 60% of VO_{2max}) but without dietary modification. Average losses during 2 to 9 months ranged from 0.4 to 3.2 kg (1–4% of total body weight) (Kay & Fiatarone Singh, 2006; Toth, Beckett, & Poehlman, 1999) with the magnitude of total fat loss related to the total number of exercise session (Greendale et al., 2000). This is just as in younger overweight populations. In contrast to its effects on body fat, most studies do not report significant effect of ET on fat-free mass (FFM). A meta-analysis identified significant increases in total FFM in only 8 of 36 studies that involved ET, and the increase were generally less than 1 kg (Toth et al., 1999). The lack of impact on FFM accretion by ET reflects the fact that this form of training, which involves repetitive, but low-force muscular contractions, does not generally stimulate significant skeletal muscle growth or improve strength (Chodzko-Zajko et al., 2009).

1.4 Resistance training

Resistance training (RT) is designed to increase strength, power, and muscular endurance (Wilmore & Costill, 2004). Muscle power is the ability to generate force rapidly and is calculated as work divided by time (Brooks et al., 2000), but muscle strength is used when a person applies maximum force (Spirduso et al., 2005). In general, strength increases after RT in older individuals seem to be greater with measures of one repetition maximum (1RM) or 3RM performance compared with isometric or isokinetic measures (Ferri et al., 2003; Frontera, Meredith, O'Reilly, Knuttgen, & Evans, 1988; Hunter, Bryan, Wetzstein, Zuckerman, & Bamman, 2002; Ochala, Lambertz, Van Hoecke, & Pousson, 2005). Older adults can substantially increase their strength after RT – with reported increases from less than 25% (Carmeli, Reznick, Coleman, & Carmeli, 2000; Ferri et al., 2003; Grimby et al., 1992; Hakkinen, Kraemer, Newton, & Alen, 2001; Hakkinen et al., 1998) to greater than 100% (Ferketich, Kirby, & Alway, 1998; Fiatarone et al., 1990; Frontera et al., 1988; Lexell, Downham, Larsson, Bruhn, & Morsing, 1995). The influence of age on the capacity to increase strength after RT is complex (Chodzko-Zajko et al., 2009). Several studies have demonstrated similar percent strength gains between older and younger participants (Hakkinen et al., 2001; Hakkinen et al., 1998; Holviala, Sallinen, Kraemer, Alen, & Hakkinen, 2006; Joseph, Davey, Evans, & Campbell, 1999; Netz, Wu, Becker, & Tenenbaum, 2005), whereas others have reported that percent strength increases are less for older compared with younger adults (Macaluso, De Vito, Felici, & Nimmo, 2000; Netz et al., 2005).

Studies imply that power-producing capabilities are more strongly associated with functional performance than muscle strength in older adults (Bassett, Schneider, & Huntington, 2004; Evans, 2000; Foldvari et al., 2000; Skelton, Young, Greig, & Malbut, 1995). Furthermore, the age-related loss of muscle power occurs at a greater rate than the loss of strength (Bassett et al., 2004; Bosco & Komi, 1980; Hakkinen & Hakkinen, 1991; Hakkinen et al., 1996;

Metter, Conwit, Tobin, & Fozard, 1997) most likely owing to a disproportionate reduction in the size of Type II fibers (Klein, Marsh, Petrella, & Rice, 2003; Lexell et al., 1995). On the other hand, substantial increases in power are demonstrated after RT in older adults (Earles, Judge, & Gunnarsson, 2001; Ferri et al., 2003; Fiatarone et al., 1994; Fielding et al., 2002; Izquierdo et al., 2001; Newton et al., 2002). Several earlier studies reported greater increases in maximum strength compared with power (Fiatarone et al., 1994; Jozsi, Campbell, Joseph, Davey, & Evans, 1999; Skelton et al., 1995) but in these studies the training protocols used traditional, slower-movement speeds. More recent studies, incorporating higher-velocity training protocols, suggest that the gains in power may be either comparable (Earles et al., 2001; Izquierdo et al., 2001; Newton et al., 2002) or greater (Earles et al., 2001) to gains in maximum strength or rate of force production.

Several studies have found that moderate- or high-intensity RT decreases total body fat mass (FM), with losses ranging from 1.6% to 3.4% (Bamman et al., 2003; W. W. Campbell, Crim, Young, & Evans, 1994; Hunter et al., 2002; Hunter, Wetzstein, Fields, Brown, & Bamman, 2000; Hunter et al., 2001; Ibanez et al., 2005; Joseph et al., 1999; Treuth, Hunter, Weinsier, & Kell, 1995). Investigators have recently attempted to determine the effect on RT on regional FM, specifically subcutaneous adipose tissue (SAT) and intra-abdominal adipose tissue (IAAT). Binder et al. (Binder et al., 2005) reported no change in IAAT or SAT in frail older adults after 12 weeks of RT, but Hunter et al. (Hunter et al., 2002) reported sex specific effects – demonstrating that elderly women, but not men, lost 12% of IAAT and 6% of SAT after 25 weeks of moderate-intensity (65-80% of 1RM). Others reported that both older men and older women decreased IAAT by 10% (Ibanez et al., 2005; Treuth, Hunter, Kekes-Szabo, et al., 1995) after 16 weeks of RT.

1.5 Physical performance and aging

Balance can be defined as the process by which we control the body’s center of mass with respect to the base of support, whether it is stationary or moving (Spirduso et al., 2005). Older adults’ ability to perform a number of basic and intermediate activities of daily living is contingent on their ability to control the multiple dimension of posture, balance and locomotion (Spirduso et al., 2005). Several studies have examined relationships among age, exercise training, and balance with the most research having been conducted in populations at risk of falling (i.e. osteoporotic women, frail older adults, subjects with a previous fall history) (Spirduso et al., 2005). Several cohort studies link higher levels of PA, particularly walking, with 30–50% reduction in the risk of osteoporotic fractures (Gillespie et al., 2003). However, these studies do not provide data on the utility of balance training alone for achieving this outcome. Lower body strength-training and walking over difficult terrain have been shown to improve balance in many studies and are recommended as a part of an exercise training intervention to prevent falls (Booth, Weeden, & Tseng, 1994; Gillespie et al., 2003; Patla, Frank, & Winter, 1992). Older individuals identified at the highest risk of falls seem to benefit from an individually tailored exercise training program that is embedded within a larger, multifactorial falls-prevention intervention (Day et al., 2002; Tinetti et al., 1994). Training programs of strength, flexibility, walking and balance (A. J. Campbell, Robertson, Gardner, Norton, & Buchner, 1999; A. J. Campbell et al., 1997; Norton et al., 2001) are shown to reduce the risk of both non-injurious and injurious falls.

Few controlled studies have examined the effect of flexibility exercise training on the range of motion (ROM) in older adults (Rider & Daly, 1991; Rogers, King, Hagberg, Ehsani, & Holloszy, 1990). There is some evidence that flexibility can be increased in the major joints by ROM exercises per se in healthy older adults but there is little consensus regarding how much (frequency, duration) and what types of exercises are the most effective (Chodzko-Zajko et al., 2009).

1.6 Physical activity and quality of life

Quality of life (QL) is a psychological construct that is most commonly defined as an individual’s conscious judgment of satisfaction with his or her life (Pavot, Diener, Colvin, & Sandvik, 1991). QL is most commonly measured in psychological research, using self-report inventories such as the Satisfaction With Life-Scale (Diener, 1984). In a review of the literature that has examined the relationship between PA and QL in old age, Rejeski and Mihalko reported that the majority of the evidence supports the conclusion that PA is positively associated with many but not all domains of QL (Rejeski & Mihalko, 2001). Researchers have shown that when PA is associated with significant increases in self-efficacy, improvements in health-related Quality of life are most likely to occur (Phillips, Wojcicki, & McAuley, 2012). In addition to physiological and psychological benefits, PA also has significant benefits for the social functioning by the elderly, for example such as the ability to adjust to changing roles and responsibilities associated with growing older of older people (Jones & Rose, 2005). Among the social benefits of PA is the empowerment of older adults to play a more active role in society. Aging creates a need to adjust to changing roles. Because of factors such as the death of friends and loved ones, retirement, financial hardship, ill health, and isolation, many older adults are forced to systematically relinquish many of the roles that they consider a meaningful part of their identity. PA can help older people better adjust to these changing roles by providing opportunities to widen their social networks, stimulate new friendships, and acquire positive new roles in retirement (Jones & Rose, 2005).

1.7 Nutrition counseling

Nutrition counseling (NC) is both a science and an art (Snetselaar, 2009). The nutrition counselor converts theory into practice and science into art. NC is a combination of nutrition expertise and psychological skill delivered by a trained nutrition counselor who understands how to work within the current medical setting. It has a focus on both foods and the nutrients contained within them, emphasizing the feelings that people experience eating (Snetselaar, 2009). Today NC sessions include analysis of factors such as nutrition science, psychology and physiology, and an eventual negotiated treatment plan followed by an evaluation (Snetselaar, 2009). Research has shown that this in-depth approach can produce excellent dietary adherence based on biological markers, even with complicated dietary regiments that are difficult to accommodate in the real world (Group, 1994; Klahr et al., 1994). Large long-term randomized controlled trials have shown the importance of NC in reversing dietary adherence problems (Berg-Smith et al., 1999; Bowen et al., 2002).

Health status has multiple contributing factors where nutrition is one of the major determinants of successful aging. Food is not only critical to one's physiological well-being but also contributes to social, cultural, and psychological quality of life. Food is an essential component of everyday life. (Bernstein & Munoz, 2012). Energy expenditure refers to the amount of energy (calories), that a person uses to breathe, circulate blood, digest food, and be physically active. To prevent weight gain, energy intake (caloric intake) must be balanced with energy expenditure (Roberts & Dallal, 2005). Several factors contribute to the amount of energy required by an individual: Basal metabolic rate (BMR), PA and to a lesser extent diet-induced thermogenesis (Pannemans & Westerterp, 1994).

Total and resting energy requirements decrease progressively with age. Although the decline in energy requirement with advancing age is multifactorial, it can be attributed in large part to decreases in PA. Physical inactivity that accompanies advancing age lowers energy requirements directly by reducing energy expenditure and leads to a decline in basal metabolic rate due to losses of lean mass. The loss of fat free mass, as well as gains in total body fat and visceral fat content continue into late life (Evans, 2004).

1.8 Intervention studies

Interventions, PA or exercise training programs can be described as planned efforts to influence individuals, groups, or populations to change, improve, or increase their PA or exercise levels, with the ultimate goal of producing positive health outcomes (Bouchard et al., 2012). An intervention program may aim to increase PA or may focus on more physiological changes in fitness or muscle strength as a causal consequence of participation in the program (Bouchard et al., 2012). It is thought that these changes, if sustained, will eventually lead to health improvements, such as reduced risk of developing coronary heart disease, improved mood or quality of life, or improved lipid profiles and blood pressure. Range of outcomes of an intervention program, including among other things the behavior of being physically active can be seen in figure 1 which was adapted from Bouchard et al (2007).

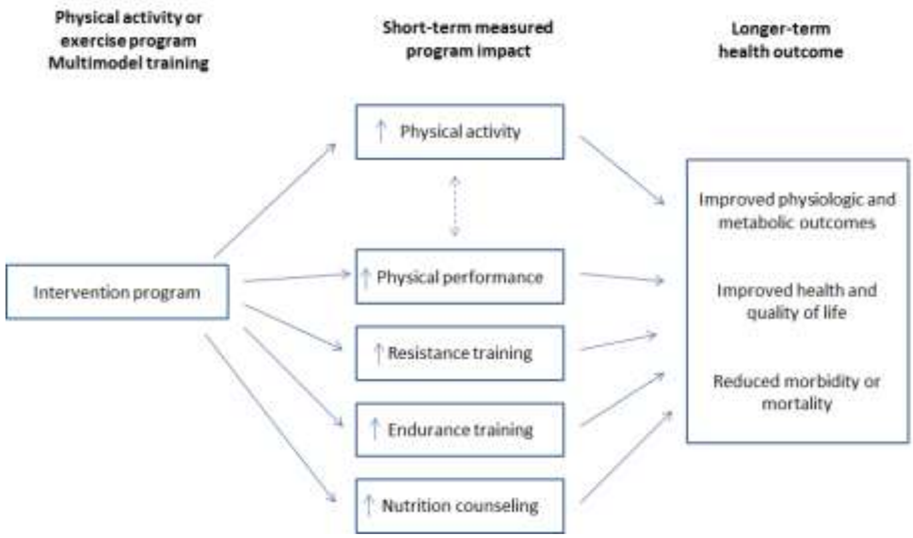

Figure 1.Range of outcomes of an intervention program, including both the behavior of being physically active and more physiologic outcomes such as physical performance, RT and ET and NC; these are the short-term effects of programs with subsequent health outcomes observed in the short term (metabolic changes) and long term (mortality).

Personal behavior influences one's health. Many people can improve their health by managing their chronic condition or engaging in health promotion behaviors (Ryan, 2009). There are numerous settings for PA and exercise programs, ranging from individual based programs to national and international efforts. Many theories are also used to explain how people initially change their behavior and then how to maintain it. This is important in the context of PA and exercise programs, because more effective approaches are based on tailoring the intervention; this means developing programs matched to people's level of motivation to change. More effective programs are based on principles of adult learning, social learning theories, and various combinations of beliefs and perceptions about the benefits and outcomes of being active (Kahn et al., 2002). The integrated theory of health behavior change suggests that health behavior change can be enhanced by fostering knowledge and beliefs, increasing self-regulation skills and abilities, and enhancing social facilitation (Bandura, 2004).

Interventions, PA or exercise programs, are usually planned efforts to influence individuals, groups, or population to change, improve, or increase their PA or exercise levels. The ultimate goal of PA or the exercise program is to produce positive health outcomes. The evidence, and whether it is caused by the intervention, is central to any policy decisions regarding program effects (Bouchard et al., 2012).

Because the aging process is associated with declines in PA, strength, and fitness but is also associated with increased risks of non-communicable diseases, decreased mobility, and increased injurious falls, the choice of an intervention program for this age group is very important. The special intervention outcomes should contain PA and exercise training programs among older adults that improve functional status and mobility, prevent falls, and improve mental health and social functioning (A. H. Taylor et al., 2004).

Different types of PA are required for elderly people; in particular progressive endurance and RT which enhance functional status have a positive influence on depression and improve glucose homeostasis. Programs such as walking may be most efficient for encouraging PA, but facilities-based programs for strength training are important (van der Bij et al., 2002). The best initiatives may therefore be multilevel interventions, with community supports to reinforce supervised programs. Tailoring programs to individual needs and capacity and including balance, gait, and RT may best support comprehensive effects and reduce the incidence of injurious falls (Bouchard et al., 2012).

There has been a growth in the number of studies and publications related to PA, maintaining the mobility and independence of older adults. There has also been increasing interest in both physical and mental fitness and interventions to maintain such fitness throughout the lifespan. In the decade since the publication of the first edition of the ACSM Position Stand "Exercise and Physical Activity for Older Adults," a body of new evidence has accumulated regarding the benefits of regular exercise and PA for older adults.

A study which focused on effects of a PA intervention on measurements of physical performance found that PA training, including 150 minutes of walking and complementary strengthening, stretching, and balance exercises, reduced the risk of major mobility impairment. The outcome also led to an improvement in chair-rise ability, standing balance, and walking speed compared to a health-education control group (Pahor et al., 2006). Many other studies investigating the effects of multi-component exercise training on functional and mobility outcomes relative to controls have also found positive results (Beling & Roller, 2009; M. B. King et al., 2002; Manini et al., 2010; Nelson et al., 2004; Shumway-Cook et al., 2007; Wolfson et al., 1996; Yang et al., 2012).

A systematic review of 29 randomized clinical trials, that was published in 1998, using similar criteria for selection and determining participation (A. C. King, Rejeski, & Buchner, 1998), involving adults over the age of 50 years, found evidence of high short-term adherence to intervention. Fewer than half of the papers reviewed gave details of specific behavioral, educational, social, cognitive or program-based strategies. Evidence showed that facility-alone strategies are less effective than those involving facility and home-based or supervised home-based intervention.

A published systematic review (van der Bij et al., 2002) considered evidence from 38 randomized controlled trials, comprising 57 PA interventions, aimed at promoting PA in older adults. In this review two outcomes were documented: participation in the intervention and changes in PA levels over time. A high adherence to the intervention was a fact, where they had a 90% participation in home-based intervention and 84% in group-based intervention. These high participation rates were not sustained in the long-term intervention, more than one year, but the decline was less strong in group-based intervention than in the home-based intervention. Only few of the included studies reported results for long-term changes in PA levels.

Vand der Bij et al. (2002) also evaluated the effect of education or counseling interventions promoting PA. The effects of these interventions, however, were more variable, with only a minority of the participants attending all planned counseling sessions. Nevertheless, all six interventions that reported short-term results, five months to one year, showed a significant increase in PA compared with a control group. Only three out of the nine interventions studies that reported long-term results showed positive effects on PA levels.

A review of interventions aimed at promoting PA through primary health care identified a few large trials that demonstrated a small long-term effect of counseling (A. H. Taylor et al., 2004). They concluded that high participation rates can be achieved with short-term PA intervention, five months to one year, and that interventions are effective in increasing PA in the short term. Evidence for long-term effectiveness was either absent with no follow-up or showed little or no difference between intervention groups and control groups. They also concluded that the failure of long-term studies to maintain high participation rates and to change PA levels suggests that more effective approaches for maintaining exercise participation, especially in the long term, are necessary (A. H. Taylor et al., 2004).

The health benefit of PA is well-established. Anyhow, only a fifth to a quarter of older adults undertake sufficient activity to accrue health benefits (Hawkins, Cockburn, Hamilton, & Mack, 2004). Maintaining PA is an important element in the success of achieving and maintaining the maximum benefit of exercise. However, adhering to PA can be difficult because the benefits of exercise are often not immediate when one needs to stick at the activity for some time in order to feel the rewards (Dishman & Buckworth, 1996). Given that many of the barriers to engaging in PA among older people are attitudinal, it was essential to take account of the psychological components, such as confidence, perceived exercise enjoyment and satisfaction of the development of PA intervention program designed for this age group (Bandura, 1986, 2004).

The self-efficacy theory refers to a person's sense of confidence in his or her ability to perform a particular behavior in a variety of circumstances (Bandura, 1986). Bandura proposed that an individual's persistence and efforts toward specific behavior is closely related to his or her level of self-efficacy. The personal perception of efficacy may further determine the type of activities chosen, the effort to be expended, and the degree of persistence in the effort (Bandura, 1977; Eysenck, 1978). The key part of the self-efficacy theory is that the stronger the individual's belief in his or her ability to perform a set of actions, the more likely they will be to initiate and persist in the given activity.

Self-efficacy beliefs are important in understanding exercise behaviors, especially for older people. The belief that one can exercise under the circumstances of constraints and impediments is likely to be associated with a greater likelihood of undertaking exercise (Sallis, Pinski, Grossman, Patterson, & Nader, 1988). Various studies have demonstrated that exercise self-efficacy is a crucial determinant of PA behavior, among other determinants, such as age, sex, the type of activity, and accessibility of facilities (A. C. King et al., 1992). According to self-efficacy theory, there are four major information sources of one's self-efficacy; performance accomplishments, vicarious learning, verbal encouragement, and physiological and affective states. These four information sources and how they have been operationalized as an intervention, what the evidence is for its effectiveness and its likely relevance for older people are described in the following sections.

Seeing others achieve or learn behaviors from others, especially for individuals who are uncertain of their capability to perform a specific behavior may help an observer believe that he or she can possess the capabilities to perform equivalent activities (Bandura, 1997). This is in line with Bandura's approach, that the relative success of vicarious experience is likely to be contingent on the comparability of the role models (Figure 2) (Bandura, 2004).

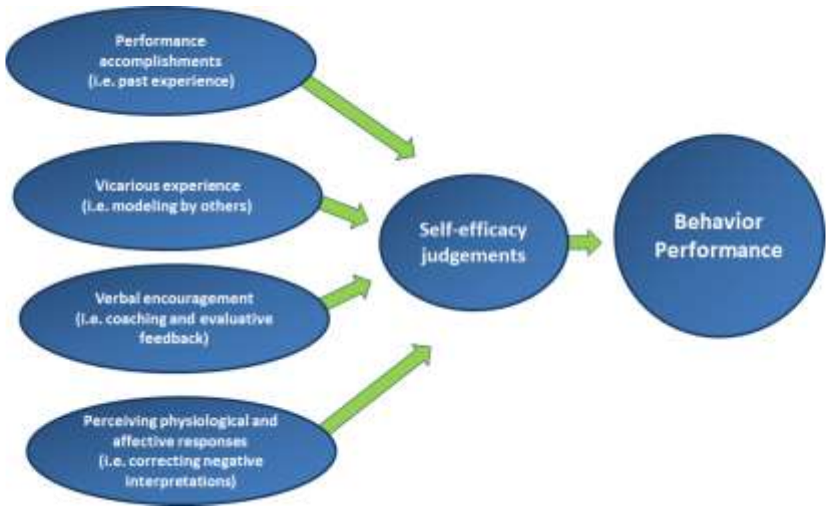

Figure 2. Behavior performance, adapted from Bandura model.

People may have a greater real or perceived need for guidance in appraising their capacity of PA and in making appropriate choices regarding ways to be active when they enter late life (Dye & Wilcox, 2006). Realistic positive feedback from significant others or professionals was proposed as an important reward to induce individuals to carry out and maintain a specific behavior (Bandura, 1997). People may interpret their successes negatively or simply ignore or underestimate their achievements. Therefore, it is important that verbal encouragement is directed in such a way that it helps people to interpret the experience as success (Bandura, 1997). Studies have pointed out that encouragement from healthcare providers significantly influenced PA particularly among older adults (Burton, Shapiro, & German, 1999; Yusuf et al., 1996). The health educators in the study, who consorted with the participants two or three times per week over a 6-month training period, were all educated teachers completing master's studies. Their normal methods of work were to provide verbal encouragement or to give realistic positive feedback as an important reward to induce every individual to carry out and maintain a specific behavior.

2 Aims

With an increasingly aging adult population, interventions that can be implemented directly within the community or public are needed to maintain the mobility, and thus well-being and independence, of older adults (Ross et al., 2013). One of the objectives was to bridge this gap with the careful implementation of a multimodal training and NC intervention and to transfer these interventions to real-world outcomes, such as walking and strength training activities, to maintain or improve mobility, independence, and quality of life.

The aim of the present thesis was to investigate the following aspects in community-dwelling elderly subjects 71-90 years of age:

I. To assess the immediate effects of a 6-month multimodal training intervention (6-MTI) and NC on functional performance, body composition, endurance, strength, PA, energy intake, quality of life and metabolic factors.

II. To evaluate at 6 and 12 months follow-up the effects and sustainability of 6-MTI and NC on physical performance, endurance and strength performance, PA, body composition, energy intake, quality of life and cardiometabolic factors.

III. To examine the immediate and long-term effects (12 months follow-up) of a 6-MTI and NC on physical performance, endurance and strength performance, PA, body composition and quality of life by sex.

IV. To study the immediate and long-term effects of a 6-MTI and NC on functional performance, body composition, endurance, strength, PA and quality of life in three different elderly age groups.

V. To develop sustainable strategies that can be used by elderly people to meet the international recommendation of PA.

3 Materials and methods

3.1 Study participants

The participants were older individuals selected from the population-based Age, Gene/Environment Susceptibility – AGES Reykjavik Study (T. B. Harris et al., 2007) among individuals who were cognitive competent (Figure 3 and 4). Those who obtained a score of ≥23 points on the Mini Mental State Examination (MMSE) (Upadhyaya, Rajagopal, & Gale, 2010) and ≥17 points on the Digit Symbol Substitution Test (DSST) (Swindell et al., 2012) were eligible for selection. Ninety-two of the 325 older individuals (>70 years), along with 25 spouses, accepted the invitation. These participants (n=117), 71 to 90 years old, were randomized in the immediate intervention group and the delayed intervention group. Each participant in the trial had to fill out a questionnaire about his or her general health, and the information was reviewed by the study physician with regard to the safety of the prescribed exercise (Appendix 1). The Short Physical Performance Battery test (SPPB) (Guralnik et al., 1994b) was also performed at screening, and a score of at least 7 points out of 12 on the test was required to be eligible for the study (Appendix 2).

Figure 3. Endurance training at Laugardalsvöllur. Part of the group in the national stadium of Iceland, where they had their regular training every week over the 6-month intervention periods.

Figure 4. Endurance training at Laugardalsvöllur. Part of the group in the national stadium of Iceland, where they had their regular training every week over the 6-month intervention periods.

3.2 Study design

The design of this intervention study was a randomized, controlled, cross-over design. The trial was conducted in Reykjavik, Iceland, in three 6-month phases after enrollment with baseline assessments (time-point 1). The first 6-month phase was an immediate intervention phase by the immediate intervention group and a control-phase by the delayed intervention group. After this first phase and assessments (time-point 2), there was a cross-over in the setup. From this time-point, the immediate intervention group did not receive any further intervention on behalf of the research staff. Then again, from this time-point, the delayed intervention group participated in the 6-month delayed intervention phase while the immediate intervention group had their 6-month cross-over phase. After the second 6-month period of the study and the third assessments (time-point 3), the last 6-month follow-up took place with the same assessments in the end of the study (time-point 4). The flow of the subjects through the trail can be seen in figure 5. Details about the study design have also been described previously (Gudlaugsson et al., 2012).

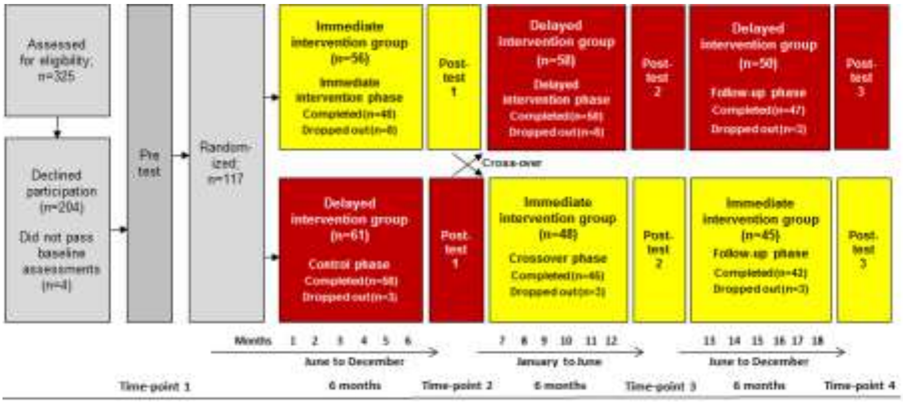

Figure 5. Flow of subjects through the trial.

The intervention program, which can be classified as a structured exercise program (Boule, Kenny, Haddad, Wells, & Sigal, 2003), was designed to increase PA but also focused on more physiological changes in fitness and widespread health promotion (see later in this chapter). Tudor-Locke and colleagues (2002) found that the structured exercise program was the major source of any vigorous activity, but there was not an expected decline in activity in other parts of the day; in fact, these programs seemed to motivate people to think about being more active outside of programs (Tudor-Locke, Jones, Myers, Paterson, & Ecclestone, 2002). It was thought that the health promotion of this intervention program could eventually lead to health improvements, such as better physical performance, reduced risk of developing coronary heart disease, improvements in quality of life, or improvement in lipid profiles and blood pressure. Every participant signed an informed consent (Appendix 3). The study was reported to Data Protection Authority and accepted by the National Bioethics Committee (VSNb20080300114/03-1) (Appendix 4).

3.3 Training intervention and nutrition counseling

The intervention consisted of a 6-MTI and NC program, with an emphasis on daily ET and twice-a-week RT. This training was supported by seven lectures, three on nutrition and four on healthy aging, ET, RT and how to train.

3.3.1 Endurance training

The aerobic exercise training or ET consisted of daily walking over the intervention phase. The duration of the training session increased progressively through the 6-month training period (Figure 6).

Figure 6. Endurance training by walking, every day for 26 weeks.

During the first week, the participants trained for 20 minutes at each session seven days a week. Then the duration was increased systematically over the training period with two recovery weeks, week 9 and 18. The average duration per day was estimated at 34 minutes. In the first and last eight weeks, a health instructor was on site twice a week, but in weeks 9 to 18, he was only on site once a week. The training took place outdoors on a 400-meter running track, except for four weeks during the winter period when the training was indoors. Other ET sessions were self-administered with participants following the training intervention plan from the program, using the Karvonen formula to maintain and gradually increase the intensity (Karvonen & Vuorimaa, 1988). During the first eight weeks, the intensity level was 50% of the difference between resting and maximum heart rate, known as the heart rate reserve (HRR). For the next 10 weeks it was increased to 60%, and during the last eight weeks it was approximately 70% of HRR. The target was to steadily increase the intensity of the training without overexerting the participants with frequency of daily walking, but also to follow recommended information of the length of a training program, 16 weeks or more, which can significantly increase VO_{2max} in healthy older adults (Chodzko-Zajko et al., 2009). The reason for planning a 6-month intervention period was because longer improvements in VO_{2max} are typically observed with longer training periods or from 20 to 30 weeks but the training intensities are not necessarily higher than >70% of VO_{2max} (Huang, Gibson, et al., 2005). Every participant wore a Polar heart-rate monitor to maintain his or her individual target HR during the training sessions.

3.3.2 Resistance training

RT took place twice a week, on Tuesdays and Fridays, in a fitness center, using the circuit series strength equipment from Life Fitness (Circuit Series Strength, Brunswick Corporation, USA). The training was always under the guidance of one or more health instructors. The RT consisted of 12 exercises for all major muscle groups and was individually-based following a systematic training plan. The focus was on resistance-endurance training for the first 3 months but for the second 3 months it was on strength-power (Figure 7).

Figure 7. Resistance-endurance and strength-power training two times a week for 26 weeks.

The exercises for the lower body included leg press, leg extensions and calf raises. Exercises for the upper body included bench press, chest cross, shoulder press, pull downs, biceps curls and triceps extensions. There were also exercises for abdominal muscles and the back (Figure 8). For the first two weeks of resistance-endurance training, the training program consisted of two sets of 12 repetitions (2x10) at 50% of one repetition maximum (1RM). Every two weeks, the working load was increased by two repetitions. The resistance-endurance training was done in the form of a circuit training program, one set at each time station. In the 13th week the repetitions were 18 in two sets. Recovery in the form of light stretching between circuits was 3-4 minutes.

The main target for the first 13 weeks of resistance-endurance training was to acclimatize the older adults to a new form of training, introduce them to the pump-technique, and to educate them about the importance of the rest between the circuits and later between the sets. The target was also to increase muscular strength as pronounced in the introduction (Hakkinen et al., 1998; Hunter, McCarthy, & Bamman, 2004; Hunter et al., 1995; Jubrias et al., 2001; Sharman et al., 2001; Vincent et al., 2002) and prepare them for resistance exercise muscle power training. The reason is that studies imply that power-producing capabilities are more strongly associated with functional performance than muscle strength in older adults (Bassett et al., 2004), and also because the age-related loss of muscle power occurs at a greater rate than the loss of strength (Hakkinen & Hakkinen, 1991).

In the second period, weeks 14 to 26, the program was changed from a resistance-endurance program to a strength-power training program. The intensity went systematically from 10RM repetitions in the 14th week down to 6RM in the 24th week. The power training program consisted of the same 12 exercises as described before. The participants finished their exercise, two sets, with one and a half minute rest between each set. The 9th and 18th week were organized as recovery weeks, with no resistance training but 20 minutes of ET every day.

Figure 8. The resistance exercises equipment. The pictures are from the fitness center World Class Laugar where the RT took place twice a week over the 6-month intervention periods.

3.4 Lectures and nutrition counseling

The exercise training intervention program (Appendix 5 and 6) was supported by seven lectures, four on healthy aging, ET, RT, how to exercise, and three lectures on nutrition. The lecturers were given by geriatricians, a physiologist, a nutritionist and health educators. The timing of the lectures was in the 1st, 4th, 12th and the 22nd week of the intervention phase. The duration of the initial session was estimated to be around 30 minutes.

3.4.1 Health education lectures

The first of four lectures was held in the first week of the 6-month intervention period in both groups. The lecture covered the intervention plan over the 6-month period, and a precise handout of exercise prescription of the training was distributed. It covered the frequency of the ET and RT and which days the training was collective, the duration of the training and the importance of the preferable intensity of the training.

The second lecture was about ET and the benefits of regular ET to improve overall health and fitness outcome, but also to prevent many adverse health situations. Studies that covered a wide range of issues were addressed and the focus was on exercise, as well as on the more broadly defined concept of PA. They were told that exercise was a form of PA that is planned, structured, repetitive, and performed with the goal of improving health or fitness. So although all exercise was PA, not all PA was exercise (Services, 2009). The emphasis was also on walking on a daily basis where the participants were educated about the three components; intensity, frequency and duration of the ET.

The third lecture was about RT and lifting weights which causes the body's muscles to work. Studies that covered the issues were addressed and the focus was on muscular strength and power and why these factors were important for all individuals and become even more important as individuals age. The discussion on the three components, intensity, frequency and duration was repeated and adjusted to the RT.

The fourth lecture was about aging and the aging process. A physician of gerontology covered the main factors that optimize successful aging, answered questions from the participants and encouraged the participants in the study to be consistent in their PA which could substantially enhance the quality of life, enabling them to continue to participate in many of the most enriching experiences of life. He also discussed the quality of life components and the eleven factors that constitute quality of life for frail elderly people. These factors of cognitive and emotional function reflect everyone's desire to maintain productivity, independence, and an active interaction with the environment. Life satisfaction and a feeling of well-being represent emotional control and mental health. These factors, which are also highly relevant to healthy older persons, have been modeled around the quality of life topic and are shown in figure 9 (Spirduso et al., 2005). But it is also clear that the physical dimension of life, which includes health, physical function, and energy and vitality, contributes in a very significant way to quality of life for the elderly (Spirduso et al., 2005).

3.4.2 Nutrition counseling

The education was based on recommendations from the Icelandic Public Health Institution for older individuals. The first informative lecture was about the importance of vegetable and fruit consumption, wholegrain bread and other cereal rich in fiber, dairy products containing low quantities of fat, cod-liver oil or other vitamin D product and water. The second lecture started with a revision from the first session, covered nutriment choice, food proportion on the plate, fish, meat and another kind of meals, salt consumption, oil and soft fat instead of hard fat. In the third and final informative lecture during the intervention phase, the lessons from the first two lectures were reiterated and the importance of a good physique, eating healthily on vacation and the presentation of the food was highlighted.

Figure 9. Quality of life model from Spirduso et al. (2005).

3.5 Theory on physical activity and nutrition counseling interventions

The multimodal training and NC intervention program in the study was based on one of the most widely applied theories in predicting health behavior and facilitating behavioral modification, the theory of self-efficacy which is a central concept of Bandura's social cognitive theory (Bandura, 1986, 2004). To strengthen this ideology seven lectures were planned, three on nutrition and four on healthy aging, ET, RT and how to exercise. All of them went through the aims of the research, discussed special aims in different fields, addressed the importance of regular participation and discussed the role of intervention studies and expected benefit from these studies. In addition, the health educators provided a positive attitude during every regular training-time over the intervention phase of the study.

The goal was to follow Bandura's bases in his concept, a behavior change on two central theories; self-efficacy and outcome expectations (Bandura, 1986). The underlying assumption of social cognitive theory suggests that behavioral change and the maintenance of that behavior are a function of the expectations about one's ability to perform a certain behavior (self-efficacy) and the expectations about the outcome resulting from performing that behavior (outcome expectations). Both self-efficacy and outcome expectations play a role in the adoption of health behaviors, the modification of unhealthy habits, and the maintenance of change (Bandura, 1991).

Performance accomplishment is the experience perceived from an individual's performance of a specific activity (Bandura, 1997). It is assumed that a sense of self-efficacy is enhanced by successful experiences and weakened by negative experiences. This may be why performance accomplishments are believed to be the most influential source among the four information sources of self-efficacy beliefs, because they are based on personal experience and, therefore, have greater authenticity for the individual (Bandura, 1986, 1997). The participants got all necessary support in the initial stage of the behavior or task to enhance confidence, but to minimize the frustration that may damage self-confidence. As an example, in the resistance training lessons, most of the participants did not have any experience of that kind of training or to follow instructions on heart rates in the once-daily endurance exercise training. Small goals were also established, such as learning the right technique to raise the load in the resistance training or to keep a tab on the walking-time through the first weeks for strengthening the performance accomplishments.

3.6 Outcome measures

Baseline measurements were performed over a two-week period before randomization. Outcome data for the immediate intervention group were collected at the end of the immediate intervention phase, after the completion of the 6-month crossover phase, and after a 6-month follow-up phase. Outcome data for the delayed intervention group were collected after the control phase, after the delayed intervention phase and after the completion of a 6-month follow-up phase. Demographic and clinical data were collected by trained research staff at the Icelandic Heart Association in Kópavogur and in a customized research area at the Football Association of Iceland in Reykjavik.

3.6.1 Short physical performance battery test (SPPB)

The SPPB test was used to measure physical performance (Guralnik et al., 1994b). The SPPB test is divided into three measurements: a balance test, a gait speed test and a chair stand test. In the balance test the participant must be able to stand unassisted without the use of a cane or walker in a) side-by-side stand, b) semi-tandem stand and c) tandem stand. For each stand, the interviewer first demonstrated the task, then supported one arm while participants positioned their feet, and asked if they were ready. Then the interviewer released the support and the participant tried to hold the position for 10 seconds. Each participant began with the semi-tandem stand, in which the heel of one foot is placed to the side of the first toe of the other foot, with the participant choosing which foot to place forward. Those unable to hold the semi-tandem position for 10 seconds were evaluated with the feet in the side-by-side position. Those who were able to maintain the semi-tandem position for 10 seconds were further evaluated with the feet in full tandem position, with the heel of one foot directly in front of the toes of the other foot. In the gait speed test (walking speed), where the length of the walk test course is 8 feet, the participants performed a normal walk as if they were walking down a street or to a store. Participants could use assistive devices if needed, and each participant was timed for two walks. The faster of the two is used for analysis. In the chair stand test, the participant stood up from a chair five times without using their arms. A straight-backed chair was placed next to a wall; participants were asked to fold their arms across their chest and to stand up from the chair once. If successful, participants were asked to stand up and sit down five times as quickly as possible, and were timed from the initial sitting position to the final standing position at the end of the fifth stand (Guralnik et al., 1994a).

3.6.2 8-foot up-and-go test

The 8-foot up-and-go test was used to measure dynamic balance (Rikli & Jones, 1999). The participant was asked to sit in the middle of a chair with the back straight, feet flat on the floor, and hands on their thighs. One foot was slightly in front of the other foot, with the torso slightly leaning forward. On a signal “go” the participant got up from the chair, walked as quickly as possible around either side of the cone and back down to the chair. The timer was stopped at the exact instant the person sat back down on the chair. The cone marker was placed exactly 8 feet (2.44 meters) away, measured from the back of the cone to a point of the floor even with the front edge of the chair. After the proper form and desired pace were demonstrated, the participant practiced it once and then two test trials were administered. Both tests were recorded to the nearest tenth of a second and the faster of the two was used for analysis (Rikli & Jones, 2001).

3.6.3 Muscle strength tests

The maximal isometric muscle strength of the thigh and hand on the dominant side was measured with the participant in a sitting position in an adjustable dynamometer chair (Good Strength, Metitur, Palokka, Finland) (Dey, Bosaeus, Lissner, & Steen, 2009). Knee extension was measured with the knee angle at 60°, the ankle fastened by a belt to a strain-gauge system and with the participant's hands gripping the edge of the seat. Handgrip strength was measured with a dynamometer fixed to the arm of the same chair with the elbow flexed at 90°, using the same instructions and methods as for the lower limbs.

3.6.4 6-Minute walk test

Endurance performance was measured using the 6-minute walk test (6MW) according to a standardized protocol (Butland, Pang, Gross, Woodcock, & Geddes, 1982; Du, Newton, Salamonson, Carrieri-Kohlman, & Davidson, 2009). The heart rate (HR) of participants was measured before and directly after completing the walk, and once more one minute later. Every participant was tested individually and was constantly monitored by a physical educator. The 6MW-test was performed indoors on a flat linoleum surface and the walking course was 16 meters. Participants wore comfortable clothing and shoes, and by the walking line there were four chairs where the participants could sit down after the test or rest if necessary during the test.

3.6.5 Physical activity

Total PA was assessed with actigraph accelerometers (AG; Model 7164, version 2.2; ActiGraph Health Services, Fort Walton Beach, Florida, USA), which were programmed to record PA over one-minute intervals (60s epoch) (Copeland & Esliger, 2009). The accelerometers were worn on the hip for six consecutive days, four week days and two weekend days, from the time the participant woke up until he or she went to sleep. Only data from monitors worn a minimum of eight hours per day, for at least two weekdays and one weekend day were included in the analysis. Average counts per minute (cpm) for these days measured by the accelerometer were calculated for each participant and were used to estimate PA level. A questionnaire was also used to estimate PA behavior in a typical week at each measurement time-point. During the training period, each participant had a 6-month intervention diary in which he or she had notes about suggested training regimens, but also confirmed their daily PA behavior as time spent on walking and participation in RT. The questionnaire and participant's diary were based on a Global Physical Activity Questionnaire (Bull, Maslin, & Armstrong, 2009).

3.6.6 Anthropometric measurements

Standing height was measured to the nearest 0.1 cm with a portable stadiometer (Seca 206, Seca Ltd, Birmingham, UK). Body weight was determined to the nearest 0.1 kg using a calibrated scale (Seca HV120, Seca Ltd, Birmingham, UK) with the participant in light clothing. Body mass index (BMI) was calculated as body mass (kg) divided by height squared (m^2).

Circumference of the waist (girth) was measured with a tape measure to the nearest 0.5 cm, from the point midway between the inferior margin of the last rib and the crest of ileum, above the umbilicus, in a relaxed standing position.

Whole-body composition, including fat mass, lean soft tissue mass (comprising muscle, inner organs, and body water), was measured using GE Lunar, iDXA Software 11.40.004 from GE Healthcare, Madison, WI, USA. These measurements were performed in a standard manner while the participant was lying in a supine position on the instruments table. From an x-ray source and K-edge filter below the participant, x-ray beams of 100KeV and 2.5ma, were emitted. The composition of the soft tissue was estimated by the ratio of beam attenuation at lower energy relative to the higher energy in soft tissue pixels; this ratio is inversely and linearly related to the percentage of fat (Rothney, Brychta, Schaefer, Chen, & Skarulis, 2009). This measurement is very simple to perform and suitable for older people and was carried out by the Icelandic Heart Association.

3.6.7 Blood pressure, resting heart rate and blood samples

Resting blood pressure (BP), systolic blood pressure (SBP), diastolic blood pressure (DBP), and HRR were measured by using Omron M4-I, fully automatic blood-pressure monitor (Omron Healthcare UK). BP and HR were measured in the supine position after a 10-min rest in a quiet room. Three recordings were made at 1-min intervals and the mean of the last two measurements was used for statistical analysis.

Blood samples were drawn after over-night fasting and were performed by the laboratory nurse at the Icelandic Heart Association, where the analyses were also performed. Total cholesterol, high-density lipoprotein (HDL) cholesterol, triglycerides (TG), high sensitivity C-reactive protein (CRP), glucose and glycated hemoglobin (HbA1c) were measured on a Hitachi 912, using reagents from Roche Diagnostics and following the manufacturer’s instructions.

Metabolic syndrome and the involvement of each of its five components; waist circumference, elevated levels of blood pressure, serum triglycerides, and plasma glucose, and low HDL-cholesterol, were identified using the definition identified by the National Cholesterol Education Program (National Cholesterol

Education Program Expert Panel on Detection & Treatment of High Blood Cholesterol in, 2002). More specifically, abdominal obesity was defined as a waist circumference ≥102 cm for males and ≥88 cm for females, elevated blood pressure was defined as a systolic and/or diastolic blood pressure ≥130 and/or 85 mmHg. Low HDL-cholesterol was defined as <1.03 mmol/l (<40 mg/dL) for males and <1.30 mmol/l (<50 mg/dL) for females. High serum TG were defined as ≥1.7 mmol/l (150 mg/dL) and elevated fasting plasma glucose level was defined as ≥6.2 mmol/l (110 mg/dL). The metabolic syndrome was defined as the presence of three or more of these components.

3.6.8 Quality of life

The health-related quality of life (HRQL) was measured with a validated generic Icelandic instrument, Icelandic Quality of Life questionnaire (IQL) (Appendix 7). The IQL-test has norms for males and females in different age groups in order to evaluate individual deviation in HRQL. Five factors explain two thirds of the variance: general health (23.4%), mental well-being (20.5%), satisfaction (9.0%), sleep (6.9%), and finance (6.3%) (Bjornsson, Tomasson, Ingimarsson, & Helgason, 1997).

3.6.9 Dietary record

Under the participant nutrition education program a three-day dietary record was turned in at three time points during the study (Appendix 8): prior to the immediate intervention (baseline), and again after 6 months, and 12 months from the start of the study. All participants received detailed instructions on how to list the food intake accurately according to specific household units presented to them and they were asked to record all foods and drinks consumed for three consecutive days, either from Thursday to Saturday or from Sunday to Tuesday. The delayed intervention group also answered a questionnaire about the hands-on activity in the kitchen. Five trained postgraduate students entered and coded each food item from the dietary records into a calculating program called ICEFOOD. ICEFOOD includes 452 food codes or recipes from the Icelandic Nutrition Council based on 394 foods from the National Nutritional Database ISGEM. Nutrient losses due to food preparation were included in the calculations. Underreporting was evaluated using the ratio of energy intake and basal metabolic rate (EI: BMR) using Schofield equations based on body weight and age (≥ 60 years) for estimating BMR (Murtagh & Hubert, 2004). A ratio of EI:BMR lower than 1.14 has been suggested to be likely to indicate an underestimation of energy intake, and was thus used as cut-off value(Puthoff & Nielsen, 2007). The number of participants with EI: BMR<1.00 was also determined given their high age.

3.7 Statistical analysis

The design of the study was cross-over with repeated measures on each subject. The analysis method has to fit the design and take into account the correlation between measured outcomes on the same subject over time. The difference in each outcome at baseline and progression over time was analyzed using a repeated measures model with a first-order autoregressive covariance structure. A parameter was included in the model to represent the mean value at each time-point for the immediate intervention group (I), and the delayed intervention group (D): μ_{I1}, μ_{I2}, μ_{I3}, μ_{I4}, μ_{D1}, μ_{D2}, μ_{D3}, μ_{D4}. An adjustment was made for age and sex. The mixed models method allows for missing values in the response on some occasions, so subjects can be included in the analysis even if a response is missing at a time-point. All participants had at least a baseline measure and a measure after the intervention. Contrasts between time-points were estimated from linear combinations of the model parameters. For example: The difference between groups at baseline was estimated as $\mu_{I1} - \mu_{D1}$; the immediate intervention effect was estimated as $\mu_{I2} - \mu_{I1}$; the change between the repeat baseline and the baseline for the delayed intervention group was estimated as $\mu_{D2} - \mu_{D1}$; the delayed intervention effect as $\mu_{D3} - \mu_{D2}$; the overall intervention effect as $(\mu_{I2} - \mu_{I1} + \mu_{D3} - \mu_{D2})/2$; and the overall improvement after the completed follow-up phase by both groups (the difference between time-point 4 and time-point 1) as $(\mu_{I4} - \mu_{I1} + \mu_{D4} - \mu_{D1})/2$.

Power calculation was conducted before initiation of the research. It was given that the mean effect-size was 0.25 SD from each point of every outcome variable with 80% power, where t-test (paired-means test) was used to measure the first against the second measurement. The sample size was estimated 100 (n = 100) at the end of the research. The participation was assumed to be 75% and the dropout about 20% because of the duration of the exercise-training intervention.

The results were generated using the SAS MIXED model procedure in SAS/STAT software, version 9.2.

4 Results

The results chapter is divided into five sections; the main results are presented in the first section. Then a summary of the three papers is followed by additional results. Paper I was about the effects of a 6-MTI on the retention of functional fitness in older adults and was published in the International Journal of Behavioral Nutrition and Physical Activity. Paper II was published in European Geriatric Medicine and covered the effects of exercise training and NC on body composition and cardio-metabolic factors in old individuals, and Paper III, published in Læknablaðið, The Icelandic Medical Journal, examined sex difference and training effect difference before and after the intervention, and after 6- and 12-month follow-ups. Finally, there is a chapter containing additional results which have not been published, and which cover different age groups within the participants and among others their functional fitness.

4.1 Main results from Papers I, II and III

The main finding of the three papers and the additional results shows that older individuals are still capable of improving their functional performance, increasing their strength and endurance and maintaining or even improving their quality of life after a moderate and systemic training intervention over a period of 6 months. The result also shows that the age group is capable of maintaining acquired changes over a period of 12 months without any assistance from practitioners.

4.2 Main findings from Paper I

The main finding of paper I, *Effects of a 6-month multimodal training intervention on retention of functional fitness in older adults: A randomized-controlled cross-over design*, were that the immediate intervention group improved in physical performance compared with the control group (delayed intervention group) by Short Physical Performance Battery (SPPB) score and 8-foot up-and-go test, and in endurance performance by 6-minute walking test (6 MW). In strength performance by knee extension the immediate intervention group improved while the delayed intervention group declined. Comparable results were seen in PA, where the immediate intervention group improved but delayed intervention group decreased their PA.

The long-term effect of the 6-MTI on the participants was assessed by estimating the mean difference in the variables measured between the baseline (time-point 1), and the 12-month follow-up (time-point 4). For the following variables, an improvement was still seen in SPPB, 8-foot up-and-go and 6MW. Knee extension, hand grip, PA and IQL were maintained, and a decrease was still seen in BMI.

4.3 Main findings from Paper II

The main finding from Paper II, *Effects of exercise training and nutrition counseling on body composition and cardiometabolic factors in old individuals*, showed an increase in PA, energy intake, and total lean mass after 6-MTI by the immediate intervention group. They also reduced their weight, FM, trunk fat mass, waist circumference, and BP. At the 6-month follow-up, the immediate intervention group saw a significant decrease in PA, energy intake, FFM and BP, and a significant increase was seen in waist circumference and FM.

After the 6-month control phase by the delayed intervention group, a significant decrease was measured in PA, SBP, FM, fat-mass of the trunk and waist circumference. After the delayed 6-MTI, by the delayed intervention group, a significant increase was measured in PA, and a decrease in weight, FM, fat-mass of the trunk, waist circumference, BP and TG.

The main finding from Paper II was a reduction in waist circumference, BMI and fat mass in both groups. The reduction was more apparent among those involved in active PA intervention, which increased energy intake by 10%, whereas a 2% reduction was observed in the delayed intervention group in their control phase. No change was seen in metabolic factors, except for TG. SBP was high in both groups but it improved steadily over the period of the study

4.4 Main findings from Paper III

Paper III, *The effects of 6 months´ multimodal training on functional performance, strength, endurance, and body mass index of older individuals. Are the benefits of training similar among women and men?*, covered sex difference in the training gains between the sexes in both groups on four time-points. The main goal of this paper was to analyze the 6-MTI effect on the sexes and examine if the training effect on the health variables would be different between sexes. The goal was also to find out if the training effect persisted by the same token or was disparate in the follow-up measurements. Papers I and II have addressed the results from two different groups without analyzing the sex differences. These two papers are also published in English but this paper was published in Icelandic. Therefore the coverage here will be more comprehensive in this sub-chapter.

The methods can be viewed in Paper I, which also contains the same following variables; BMI, SPPB, 8-foot up-and-go, strength of the thigh measured by adjustable dynamometer chair and 6MW test. PA was measured with actigraph accelerometers as mentioned in the other two papers. The approach to the statistical analysis was the same as in paper I.

Baseline characteristics of subjects randomized to the immediate intervention group and the delayed intervention group can be seen in table 1. Altogether, 48 participants (85.7%), 22 males and 26 females from the immediate intervention group finished the 6-MTI but 50 participants (82%), 25 males and 25 females, from the delayed intervention group finished 6-MTI (Table 1).

Table 1. Baseline characteristics of subjects randomized to immediate intervention group and delayed intervention group.

	Male (n=54)	Female (n=63)	Sex difference
Characteristic	(n) Mean ± SD (Range)	(n) Mean ± SD (Range)	*p*-value
Number (n)			
Immediate intervention group	25	31	.004
Delayed intervention group	29	32	.265
Age (year)			
Immediate intervention group	81.9 ± 4.8 (75–90)	79.9 ± 4.6 (73–89)	.004
Delayed intervention group	79.9 ± 4.3 (71–88)	77.8 ± 3.8 (72–85)	.048
BMI (points)			
Immediate intervention group	26.9 ± 4.6 (22.5–45.9)	28.2 ± 5.7 (20.6–43.2)	.480
Delayed intervention group	27.1 ± 2.9 (20.1–32.2)	27.7 ± 3.8 (22.9–36.3)	.789
SPPB (points)			
Immediate intervention group	10.0 ± 1.6 (7–12)	10.2 ± 1.4 (7–12)	.875
Delayed intervention group	9.9 ± 1.5 (7–12)	10.0 ± 1.0 (7–12)	.979
Balance (points)			
Immediate intervention group	3.2 ± 0.9 (2–4)	3.4 ± 0.8 (2–4)	.695
Delayed intervention group	3.2 ± 0.9 (1–4)	3.3 ± 0.9 (1–4)	.708
Walk 4 m (s)			
Immediate intervention group	3.5 ± 0.7 (2.6–5.1)	3.8 ± 1.0 (2.3–8.4)	.013
Delayed intervention group	3.5 ± 0.6 (2.8–4.9)	3.6 ± 0.4 (2.7–4.4)	.609
Chair (s)			
Immediate intervention group	12.9 ± 2.8 (7.8–16.9)	12.7 ± 2.4 (7.7–18.0)	.939
Delayed intervention group	13.2 ± 2.8 (9.0–19.8)	13.1 ± 2.4 (8.4–19.9)	.908
8-feet up-and-go (s)			
Immediate intervention group	6.1 ± 1.2 (4.4–9.0)	6.7 ± 1.6 (4.6–13.2)	.010
Delayed intervention group	6.5 ± 1.3 (4.4–9.7)	(32) 6.5 ± 0.9 (4.6–9.2)	.699
Strength of the thigh (Newton)			
Immediate intervention group	394.4 ± 81.6 (212.2–547.5)	275.1 ± 71.6 (127.1–386.6)	<.001
Delayed intervention group	396.2 ± 75.0 (209.8–585.9)	271.7 ± 62.2 (150.0–405.4)	<.001
6MW (m)			
Immediate intervention group	465.4 ± 91.7 (255.0–638.0)	437.6 ± 78.4 (274.0–656.0)	.034
Delayed intervention group	486.5 ± 72.7 (380.0–612.0)	453.7 ± 57.3 (333.0–562.0)	.248
PA (cpm)			
Immediate intervention group	288.7 ± 144.8 (103.4–588.5)	235.8 ± 98.0 (100.1–445.9)	.048
Delayed intervention group	248.1 ± 113.6 (105.8–537.4)	259.3 ± 92.0 (109.4–488.7)	.673

Values are shown as numbers in groups for sex (n), means with standard deviation (SD), range and *p*-value. SD: Standard deviation; BMI: Body mass index; SPPB: Short Physical Performance Battery Test: s: Seconds; 6MW: Six meters walking test; m: meter; PA: Physical activity; cpm: Average counts per minute.

Table 2. Outcomes for males and females who completed the immediate intervention phase and the control phase and sex differences.

Values are shown as means with 95% confidence interval in means (95% CI), effect difference between sex and significant difference (p-value); * *p*<0.05; ** *p*<0.01; *** *p* <0.001. The results are shown with adjustment for age and the data were worked on logarithm. † Percentage from logarithm data. SD: Standard deviation; BMI: Body mass index; SPPB: Short Physical Performance Battery Test: s: Seconds; 6MW: Six meters walking test; m: meter; PA: Physical activity; cpm: Average counts per minute.

Table 3. Outcomes for males and females who completed the delayed immediate intervention phase and the cross-over phase and sex differences.

Values are shown as means with 95% confidence interval in means (95% CI), effect difference between sex and significant difference (p-value); * *p*<0.05; ** *p*<0.01; *** *p* <0.001. The results are shown with adjustment for age and the data were worked on logarithm. ✝ Percentage from logarithm data. SD: Standard deviation; BMI: Body mass index; SPPB: Short Physical Performance Battery Test: s: Seconds; 6MW: Six meters walking test; m: meter; PA: Physical activity; cpm: Average counts per minute.

Table 4. Common results for males and females in both groups, and sex effect difference in those who finished the 6-MTI.

	Effects and difference at the end of the 6-MTI			
	6-MTI	6-MTI	Difference	
Variables (denomination)	**Male** (n=41) Effect † (95% CI)	**Female** (n=48) Effect † (95% CI)	**Sex** Effect difference † (95% CI)	*p*-value for sex difference
BMI (kg/m²)	-1.6 (-2.4, -0.8)***	-1.8 (-2.5, -1.0)***	0.2 (-0.9, 1.3)	0.769
SPPB (points)	4.6 (1.2, 8,2)**	6.8 (3.5, 10,3)***	-2.1 (-7.0, 2.6)	0.372
Balance (points)	0.9 (-7.9, 10.4)	6.2 (-2.5, 15.7)	-5.0 (-16.1, 7.6)	0.417
Walk 4 m (s)	-5.6 (-8.6, -1.7)**	-5.0 (-8.6, -1.3)**	-0.6 (-6.0, 5.2)	0.837
Chair (s)	-10.8 (-14.4, -7.0)***	-11.7 (-15.1, -8.1)***	1.0 (-4.5, 6.9)	0.723
8-foot up-and-go (s)	-10.0 (-13.5, -6.4)***	-9.7 (-13.0, -6.2)***	-0.4 (-5.7, 5.1)	0.882
Strength of the thigh (Newton)	8.2 (3.6, 13.0)***	12.7 (8.2, 17.4)***	-4.0 (-9.6, 1.9)	0.179
6MW (m)	5.4 (2.7, 8.2)***	6.0 (3.4, 8.7)***	-0.5 (-4.1, 3.1)	0.766
PA (cpm)	32.2 (17.6, 48.7)***	39.0 (24.5, 55.2)***	-4.9 (-19.0, 11.7)	0.540

Values are shown as means with 95% confidence interval in means (95% CI), effect difference between sex and significant difference (p-value); * p<0.05; ** p<0.01; *** p <0.001. The results are shown with adjustment for age and the data were worked on logarithm. † Percentage from logarithm data. SD: Standard deviation; BMI: Body mass index; SPPB: Short Physical Performance Battery Test: s: Seconds; 6MW: Six meters walking test; m: meter; PA: Physical activity; cpm: Average counts per minute.

Effect from 6-MTI in the immediate intervention group and changes on the control phase in the delayed intervention group can be seen in table 2. The outcome results by males and females showed an approximate 6% increase in the SPPB test, 8–9% increase in the 4-minute walking test and about 13% increase in the chair measurement from the SPPB test. In the 8-foot up-and-go test a 9–10% increase was seen and BMI decreased by about 2%, both in males and females. In 6MW, the walking distance increased in males around 10% and around 6% in females. An approximate 14% increase was seen in the strength test in females and 5% in males. The PA during the intervention period increased in both sexes by approximately 15% but the results in PA were not statistically significant. The effect difference of sex was not statistically significant in the intervention phase be the immediate intervention group (Table 2). The results from the control phase by the delayed intervention group can also be seen in table 2.

Results from the 6-month cross-over phase by the immediate intervention group and the delayed intervention phase by the delayed intervention group can be seen in table 3. The females in the immediate intervention group increased their outcome in the chair rises about 7%. The males decreased their PA (16%) compared to the end of the 6-MTI phase. The effect difference of sex in BMI was statistically significant in the cross-over phase by the immediate intervention group. Similar changes were seen by males and females by the delayed intervention phase by the delayed intervention group as by the immediate intervention group before. The sexes responded comparable to the 6-MTI in the delate intervention phase (Table 3).

The common results from both groups, on the one hand in the males (n=41) and on the other hand in the females (n=48) who finished the 6-MTI can be seen in table 4. The result shows statistically significant results within sex in every variable except for the SPPB balance test by the females.

The total effect on each sex, changes from the baseline measurement (time-point 1) to the end of the study (time-point 4) and if there is a training effect on gender in the end of the study can be seen in table 5.

Table 5. Common results for males and females in both groups and sex effect difference at the end of the study (18 months after the baseline measurements).

Common sex difference at the end of the study				
	Common effects	Common effects	Difference	
Variables (denomination)	Males Effect † (95% CI)	Females Effect † (95% CI)	Sex Effect difference † (95% CI)	*p*-value for sex difference
BMI (kg/m²)	-1.9 (-3.3, -0.5)**	-2.6 (-3.9, -1.3)***	0.7 (-1.2, 2.6)	0.461
SPPB (points)	11.6 (6.6, 16.8)***	11.4 (6.8, 16.3)***	0.2 (-5.9, 6.6)	0.961
Balance (points)	9.6 (-1.5, 22.0)	8.3 (-1.9, 19.5)	1.2 (-12.5, 17.1)	0.868
Walk 4 m (s)	-17.5 (-22.1, -12.6)***	-19.5 (-23.7, -15.0)***	2.4 (-5.3, 10.8)	0.548
Chair (s)	-20.6 (-25.4, -15.4)***	-21.8 (-26.3, -17.1)***	1.6 (-6.8, 10.8)	0.715
8-foot up-and-go (s)	-14.2 (-19.1, -9.0)***	-12.6 (-17.3, -7.7)***	-1.8 (-9.4, 6.5)	0.661
Strength of the thigh (Newton)	0.7 (-6.0, 7.9)	2.2 (-4.1, 8.9)	-1.4 (-10.3, 8.2)	0.761
6MW (m)	4.5 (0.1, 9.0)*	3.7 (-0.3, 8.0)	0.7 (-5.0, 6.7)	0.815
PA (cpm)	-0.2 (-15.0, 17.1)	-1.1 (-18.8, 14.7)	0.9 (-18.8, 25.4)	0.934

Values are shown as means with 95% confidence interval in means (95% CI), effect difference between sex and significant difference (p-value); * $p<0.05$; ** $p<0.01$; *** $p<0.001$. The results are shown with adjustment for age and the data were worked on logarithm. † Percentage from logarithm data. SD: Standard deviation; BMI: Body mass index; SPPB: Short Physical Performance Battery Test: s: Seconds; 6MW: Six meters walking test; m: meter; PA: Physical activity; cpm: Average counts per minute.

The conclusion of Paper III was that multimodal training intervention can have positive effects on physical performance in older individuals, the sexes respond similarly to the organized training intervention, and retain achieved improvement for at least 12 months. The research indicates that moderate but systemic training for this age group could be a part of conventional health service for this age group.

Table 6. Values in means and range at three time-points in three different age groups; 71-75 (n=28; mean age 74), 76-80 (n=41; mean age 78), and 81-90 (n=48; mean age 84).

Variables and age-groups	Time-point 1 Mean SD (range)	Time-point 2 Mean SD (range)	Time-point 3 Mean SD (range)
BMI (kg/m^2)			
• 71-75	29.2 ± 4.6 (20.9–43.2)	28.7 ± 4.8 (20.9–44.0)	28.6 ± 4.9 (20.6–44.0)
• 76-80	27.4 ± 4.7 (20.6–45.9)	26.8 ± 4.7 (20.1–44.4)	26.7 ± 4.8 (20.1–44.1)
• 81+	26.3 ± 3.7 (19.9–36.6)	25.8 ± 3.3 (20.2–37.4)	26.4 ± 3.8 (20.0–36.4)
8-foot up-and-go (s)			
• 71-75	6.26 ± 1.6 (4.5–13.9)	5.52 ± 0.8 (4.3–6.9)	5.31 ± 0.8 (3.7–7.3)
• 76-80	6.34 ± 1.7 (4.4–14.9)	5.76 ± 1.4 (3.6–11.9)	5.57 ± 0.9 (4.0–7.5)
• 81+	6.74 ± 1.1 (4.6–9.4)	5.83 ± 0.9 (4.1–8.1)	5.74 ± 1.0 (4.0–8.6)
SPPB (points)			
• 71-75	10.5 ± 1.5 (7.0–12.0)	11.3 ± 1.0 (8.0–12.0)	11.5 ± 0.7 (10.0–12.0)
• 76-80	10.3 ± 1.2 (8.0–12.0)	10.7 ± 1.2 (8.0–12.0)	11.1 ± 1.0 (9.0–12.0)
• 81+	9.9 ± 1.5 (7.0–12.0)	10.4 ± 1.3 (7.0–12.0)	10.9 ± 1.3 (7.0–12.0)
SPPB - Balance (points)			
• 71-75	3.46 ± 0.8 (1.0–4.0)	3.75 ± 0.8 (2.0–4.0)	3.68 ± 0.5 (3.0–4.0)
• 76-80	3.46 ± 0.7 (2.0–4.0)	3.46 ± 0.8 (2.0–4.0)	3.49 ± 0.7 (2.0–4.0)
• 81+	3.09 ± 0.9 (2.0–4.0)	3.15 ± 0.9 (1.0–4.0)	3.38 ± 0.7 (2.0–4.0)
SPPB – 4 m walk (s)			
• 71-75	3.63 ± 1.1 (2.7–8.4)	3.26 ± 1.1 (2.3–4.9)	2.95 ± 0.6 (2.1–4.6)
• 76-80	3.37 ± 0.5 (2.3–4.6)	3.23 ± 0.6 (2.2–5.4)	3.04 ± 0.5 (2.3–3.9)
• 81+	3.58 ± 0.5 (2.5–5.1)	3.40 ± 0.6 (2.5–4.7)	3.24 ± 0.6 (2.5–3.6)
SPPB – Chair (s)			
• 71-75	12.17 ± 2.6 (7.7–20.1)	10.58 ± 1.8 (7.5–15.5)	9.79 ± 1.6 (7.2–13.4)
• 76-80	12.69 ± 2.6 (7.8–18.5)	11.15 ± 1.8 (7.7–15.6)	10.67 ± 2.2 (6.4–17.3)
• 81+	12.88 ± 2.5 (8.6–10.0)	11.21 ± 2.0 (7.0–16.8)	10.68 ± 2.0 (5.8–18.8)
Strength of the thigh (N)			
• 71-75	335 ± 108 (98–512)	389 ± 107 (154–615)	372 ± 113 (149–637)
• 76-80	320 ± 85 (134–521)	352 ± 81 (146–546)	324 ± 69 (78–461)
• 81+	320 ± 97 (127–548)	347 ± 82 (182–513)	349 ± 77 (230–468)
6 minutes walking (m)			
• 71-75	479 ± 87 (304–656)	504 ± 74 (384–651)	502 ± 78 (293–637)
• 76-80	462 ± 70 (270–638)	488 ± 78 (262–650)	489 ± 72 (292–638)
• 81+	434 ± 69 (255–566)	467 ± 72 (277–584)	467 ± 65 (368–579)
Physical activity (cpm)			
• 71-75	241 ± 107 (111–553)	356 ± 114 (199–602)	308 ± 119 (109–617)
• 76-80	244 ± 90 (25–446)	339 ± 129 (180–678)	274 ± 117 (85–662)
• 81+	231 ± 119 (97–589)	300 ± 125 (126–733)	240 ± 99 (108–525)
Quality of life (points)			
• 71-75	55.6 ± 4.6 (44–62)	56.8 ± 4.7 (44–63)	57.5 ± 3.8 (47–64)
• 76-80	57.3 ± 3.3 (50–64)	57.3 ± 4.3 (46–64)	57.5 ± 4.1 (47–64)
• 81+	53.9 ± 6.6 (40–65)	55.4 ± 6.1 (42–66)	54.6 ± 6.7 (41–66)

Values are shown as numbers in age groups (n), means with standard deviation (SD) and range at the following time points: Baseline (time-point 1), after 6-month training intervention (time-point 2), and after 6-month follow-up (time-point 3) by different age groups. BMI: Body mass index; cpm: Average counts per minute; m: meters; N: Newton; s: seconds; SD: Standard deviation; SPPB: Short physical performance battery test.

Table 7. Mean changes between time-points 1 and 2, 2 and 3, and between time-points 1 and 3 for subjects in three different age groups; 71-75 (n=28, mean age 74), 76-80 (n=41; mean age 78), and 81-90 (n=48; mean age 84).

	Intervention effect	Follow-up effect	Overall effect
	Change from time-point 1 to 2	Change from time-point 2 to 3	Change from time-point 1 to 3
Variables and age-groups	Diff in means (95% CI)	Diff in means (95% CI)	Diff in means (95% CI)
BMI (kg/m^2)			
• 71-75	-0.49 (-0.8 to -0.2)***	-0.05 (-0.3 to 0.2)	-0.55 (-1.0 to -0.1)**
• 76-80	-0.50 (-0.7 to -0.2)***	-0.07 (-0.3 to 0.2)	-0.57 (-0.9 to -0.2)**
• 81+	-0.40 (-0.7 to -0.1)**	0.08 (-0.2 to 0.4)	-0.32 (-0.1 to 0.1)
8-foot up-and-go (s)			
• 71-75	-0.76 (-1.2 to -0.4)***	-0.18 (-0.6 to 0.2)	-0.94 (-1.5 to -0.4)***
• 76-80	-0.50 (-0.9 to -0.1)**	-0.11 (-0.5 to 0.3)	-0.61 (-1.1 to -0.2)**
• 81+	-0.67 (-1.1 to -0.3)***	0.15 (-0.6 to 0.3)	-0.83 (-1.3 to -0.3)***
SPPB (points)			
• 71-75	0.87 (0.4 to 1.3)***	0.17 (-0.3 to 0.6)	1.03 (0.5 to 1.6)***
• 76-80	0.38 (0.0 to 0.8)	0.27 (-0.1 to 0.7)	0.64 (0.2 to 1.1)**
• 81+	0.51 (0.1 to 0.9)*	0.46 (0.0 to 0.9)*	0.93 (0.5 to 1.5)***
SPPB - Balance (points)			
• 71-75	0.27 (-0.1 to 0.6)	-0.06 (-0.4 to 0.4)	0.21 (-0.2 to 0.6)
• 76-80	-0.01 (-0.3 to 0.3)	0.00 (-0.3 to 0.3)	-0.01 (-0.4 to 0.3)
• 81+	0.09 (-0.2 to 0.4)	0.22 (-0.1 to 0.6)	0.31 (-0.1 to 0.7)
SPPB – 4 m walk (s)			
• 71-75	-0.42 (-0.6 to -0.2)***	-0.29 (-0.5 to -0.1)**	-0.71 (-1.0 to -0.5)***
• 76-80	-0.16 (-0.3 to 0.0)	-0.11 (-0.3 to 0.1)	-0.27 (-0.5 to -0.1)*
• 81+	-0.12 (-0.3 to 0.1)	-0.21 (-0.4 to 0.0)*	-0.33 (-0.6 to -0.1)**
SPPB – Chair (s)			
• 71-75	-1.66 (-2.3 to -1.0)***	-0.75 (-1.4 to -0.1)*	-2.41 (-3.3 to -1.5)***
• 76-80	-1.48 (-2.1 to -0.9)***	-0.59 (-1.2 to 0.0)	-2.08 (-2.9 to -1.3)***
• 81+	-1.35 (-2.0 to -0.7)***	-0.72 (-1.4 to 0.0)*	-2.07 (-2.9 to -1.2)***
Strength of the thigh (N)			
• 71-75	51.2 (34.1 to 68.4)***	-15.7 (-32.7 to 1.3)	35.5 (12.6 to 58.4)**
• 76-80	30.2 (15.2 to 45.1)***	-24.0 (-39.1 to -8.9)**	6.2 (-13.8 to 26.2)
• 81+	19.6 (4.0 to 35.2)*	-0.5 (-17.3 to 16.2)	19.1 (-2.2 to 40.4)
6 minutes walking (m)			
• 71-75	27.8 (12.8 to 42.7)***	-5.5 (-20.4 to 9.5)	22.3 (2.3 to 42.3)*
• 76-80	25.3 (12.7 to 38.0)***	-3.8 (-16.9 to 9.2)	21.5 (4.0 to 39.0)*
• 81+	18.5 (4.9 to 32.2)**	-4.4 (-19.9 to 11.0)	14.1 (-5.4 to 22.5)
Physical activity (cpm)			
• 71-75	101 (53 to 149)***	-36 (-80 to 8)	65 (8 to 122)*
• 76-80	92 (54 to 131)***	-58 (-94 to -23)**	34 (-12 to 80)
• 81+	57 (21 to 94)**	-62 (-100 to -24)**	-5 (-51 to 41)
Quality of life (points)			
• 71-75	1.2 (0.0 to 2.5)	0.7 (-0.5 to 2.0)	2.0 (0.3 to 3.7)
• 76-80	-0.1 (-1.2 to 1.0)	-0.1 (-1.3 to 1.0)	-0.2 (-1.7 to 1.3)
• 81+	1.5 (0.4 to 2.0)*	-1.3 (-2.6 to 0.0)*	0.2 (-1.4 to 1.9)

Values are shown as mean changes (95% CI) within different age groups between time-point 1 and 2, 2 and 3 and between time-point 1 and 3, and significant differences; * $p < .05$, ** $p < .01$, *** $p < .001$. BMI: Body mass index; cpm = Average counts per minute; m = meters; N = Newton; SD = Standard deviation; SPPB = Short physical performance battery test.

4.5 Additional results

Additional results cover a different perspective on the data where the whole group (n=117) was divided based on the age brackets 71–75 (n=28) with a mean age of 73.7 years, 76–80 (n=41) with a mean age of 78.2, and 81 years and older (n=48) which had a mean age of 84. The purpose of this analysis was to evaluate the intervention effect on these three different age groups after participation in 6-

month training, and secondly to examine the status of the same variables after 6-month follow-up (Table 6 and 7). These age groups are commensurable with the age rate and table set-ups in Senior Fitness Test Manual (Rikli & Jones, 2001). Outcome measures at three time-points and the intervention effect from time-point 1 to time-point 2, the follow-up effect from time-point 2 to 3 and the overall effect; a change from time-point 1 to time-point 3 can be seen in table 6 and 7.

The results of BMI measurements show that all groups had a statistical decrease in BMI after the intervention period. The overall effect on BMI at time-point 3 was statistically significant in the 71–75 and 76–80 age group (Table 7, Figure 10).

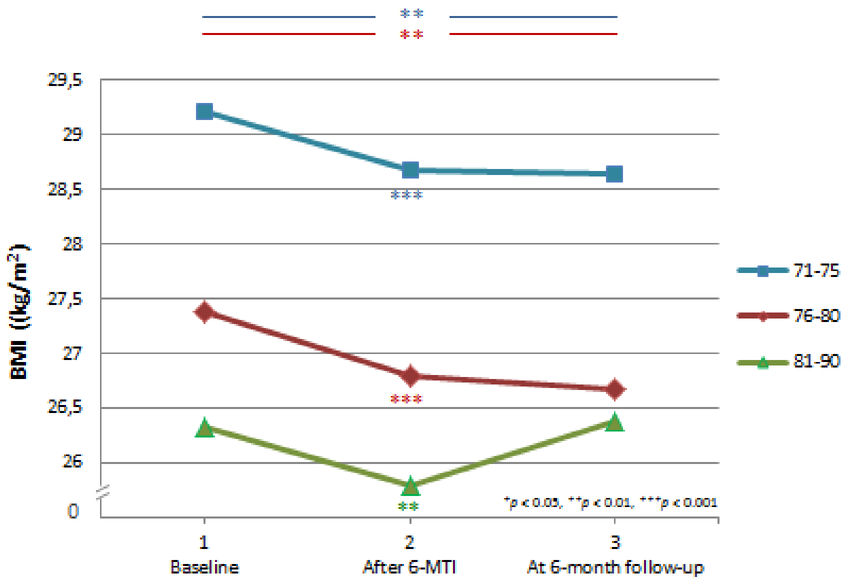

Figure 10. Outcome in BMI measurements from the three different age groups at three time-points; baseline (1), after 6-month training (2), and after 6-month follow-up (3).

The results of the 8-foot up-and-go test show improvements in all age groups after the intervention period and also at time-point 3 in contrast to baseline (Table 7, Figure 11).

The total results from the SPPB test show positive improvements by all age groups at time-point 3 in contrast to baseline (Table 7, Figure 12). In the balance test of the SPPB the participants maintained their baseline outcome at all time-points (Table 7, Figure 13). In the 4-m walk test, positive improvements can still been seen at 6-month follow-up by all age groups in contrast to baseline (Table 7, Figure 14). In the chair rise part of the test, positive improvements can still been seen at the 6-month follow-up in all age groups compared to baseline (Table 7, Figure 15).

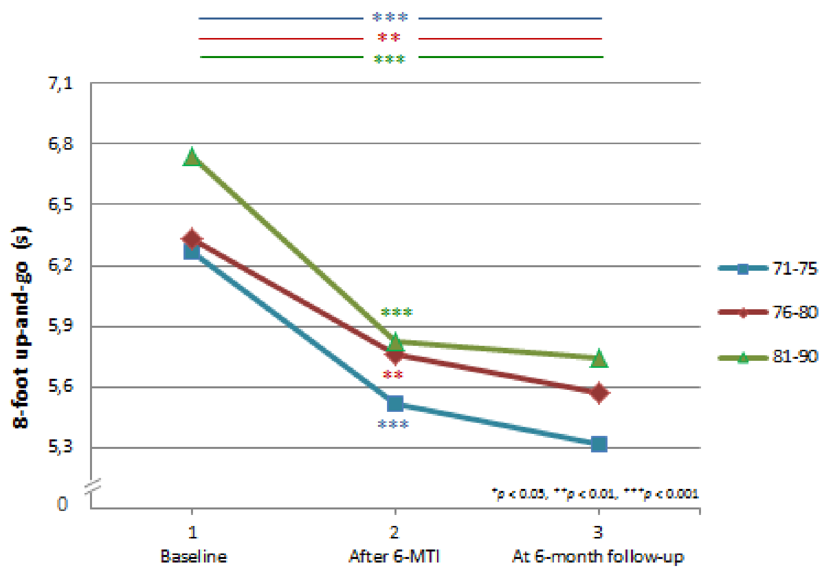

Figure 11. Outcome in 8-foot up-and-go measurements from the three different age groups at three time-points; baseline (1), after 6-month training (2), and after 6-month follow-up (3).

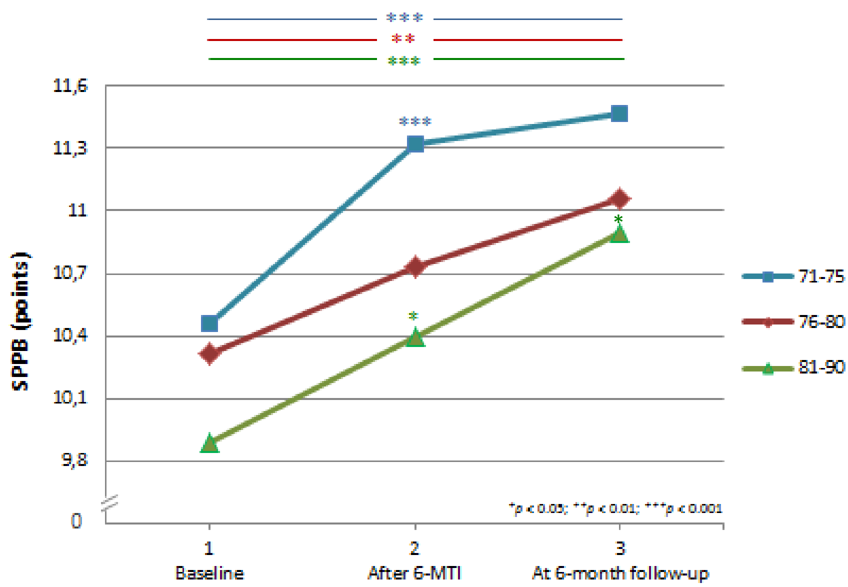

Figure 12. SPPB outcome measures from the three different age groups at three time-points; baseline (1), after 6-month training (2), and 6-month follow-up (3).

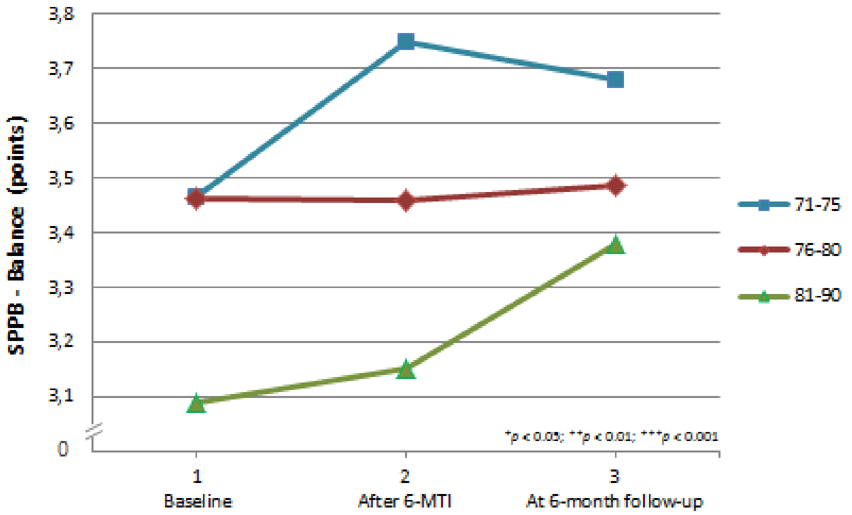

Figure 13. Outcome measures, SPPB-Balance, from the three different age groups at three time-points; baseline (1), after 6-month training (2), and 6-month follow-up (3).

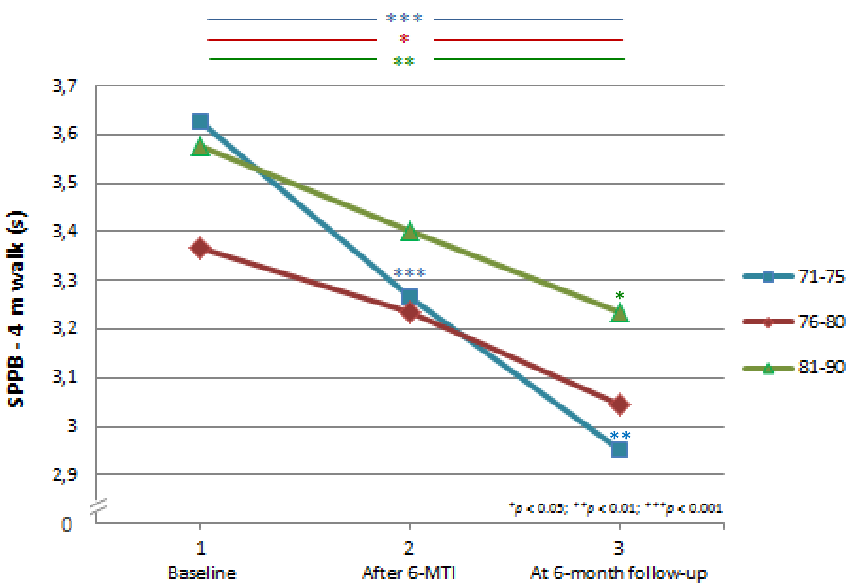

Figure 14. Outcome measures, 4-meter walk, from the three different age groups at three time-points; baseline (1), after 6-month training (2), and 6-month follow-up (3).

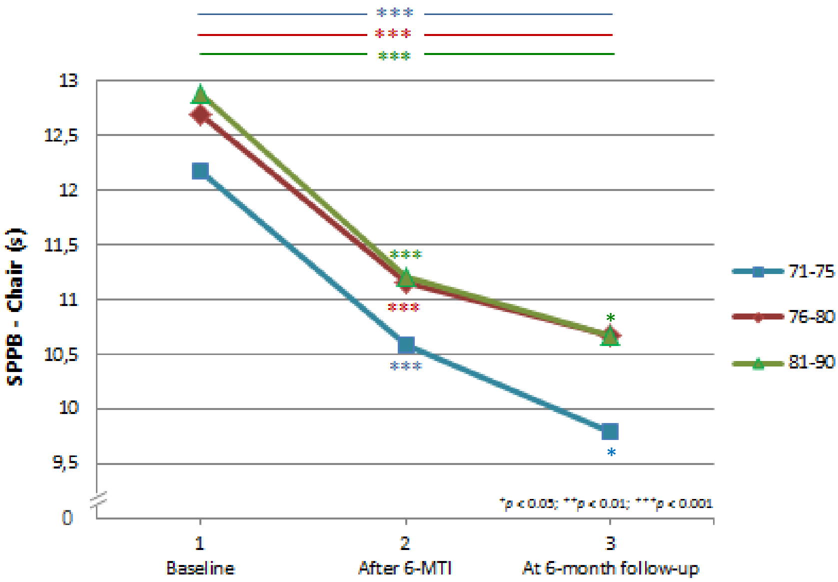

Figure 15. Outcome measures, SPPB – Chair, from the three different age groups at three time-points; baseline (1), after 6-month training (2), and 6-month follow-up (3).

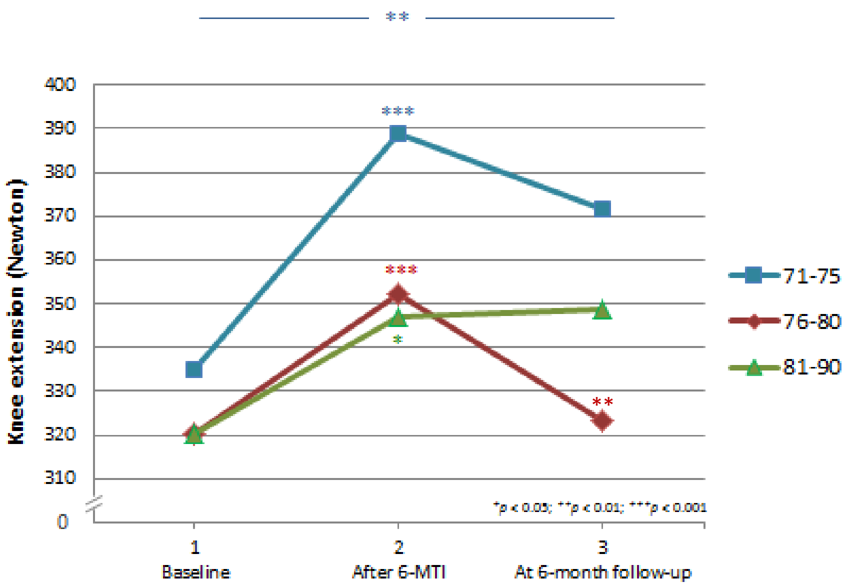

Figure 16. Knee extension outcome measures from the three different age groups at three time-points; baseline (1), after 6-month training (2), and 6-month follow-up (3).

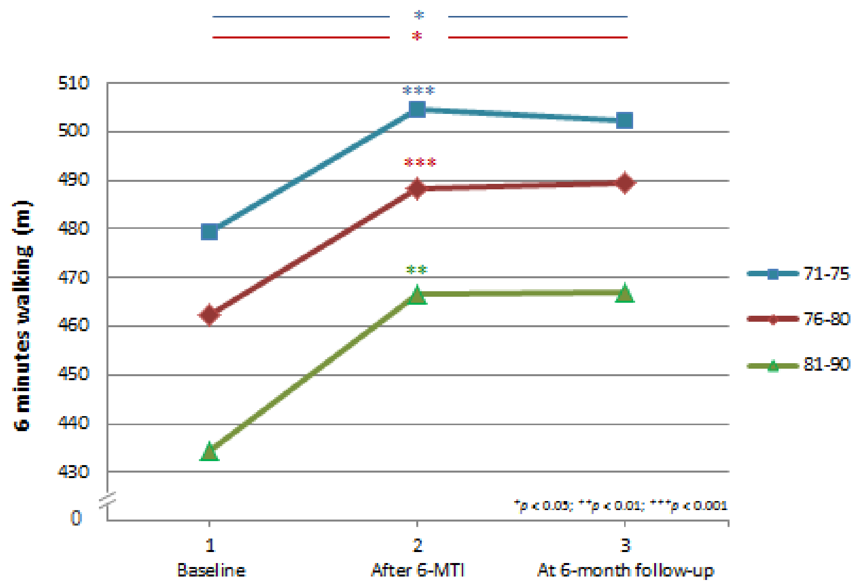

Figure 17. Outcome measures, 6 minutes walking, from the three different age groups at three time-points; baseline (1), after 6-month training (2), and 6-month follow-up (3).

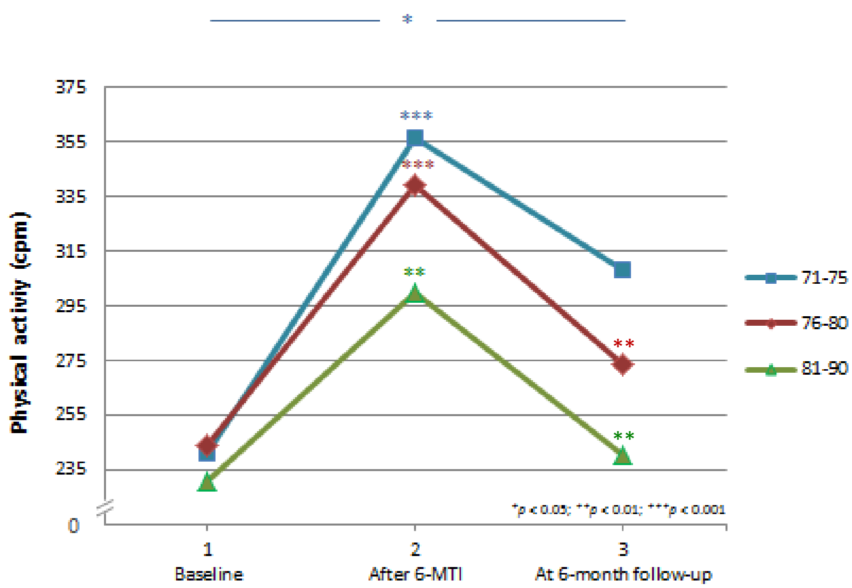

Figure 18. Outcome in PA measures, from the three different age groups at three time-points; baseline (1), after 6-month training (2), and 6-month follow-up (3).

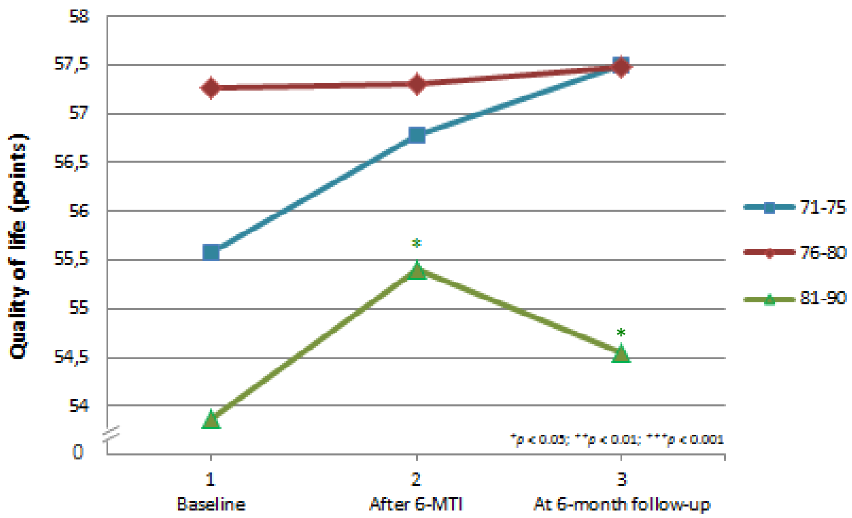

Figure 19. Quality of life outcome measures from the three different age groups at three time-points; baseline (1), after 6-month training (2), and 6-month follow-up (3).

In the knee extension strength test, the strength of the thigh, improvements by all groups were seen after the intervention. At the 6-month follow-up the intervention effect was maintained compared to 6-MTI in two groups, but decreased in the 76–80 age group. The overall effect, change from time-point 1 to 3, a statistical improvement was still seen in the 71–75 age group. The other two groups maintained their strength of the thigh compared to baseline at this time-point (Table 7, Figure 16).

In 6MW, all age groups had an improvement after the intervention. The overall effect at time-point 3 showed that the 71–75 and the 76–80 group still improved compared to baseline but the 81+ group maintained the same level (Table 7, Figure 17).

In PA, an increase was seen in all age groups after 6-month intervention. At the 6-month follow-up, the results decreased in all groups compared to 6-MTI. The overall effect at time-point 3 showed that the 71–75 age group still improved compared to baseline, but the other two groups maintained the same level (Table 7, Figure 18).

In the quality of life test, the 81+ group had an improvement after the 6-MTI, but the other two groups maintained the same level. At time-point 3, all of the groups maintained the same level compared to the baseline (Table 7, Figure 19).

5 Discussion

The main purpose of this thesis was to assess the immediate and long-term effects of a 6-MTI on physical performance, body composition and cardio-metabolic risk factors in older individuals. The goal was also to develop sustainable methods and strategies in preventive care of old people.

The immediate effects of 6-MTI on physical performance showed a significant positive improvement in functional fitness, as well as in the 8-foot up-and-go test and short physical performance test (SPPB), in the 6-minute walking test and maximal isometric muscle strength test for the thigh. These results are in line with similar studies (Strasser, Keinrad, Haber, & Schobersberger, 2009), which investigated the efficacy of systematic ET and RT on muscle strength and endurance performance in elderly people. The results from the study are also comparable with a study which examined the effects of multicomponent training on functional fitness in older people (Toraman, Erman, & Agyar, 2004). The results are also in agreement with a systematic review that covers PA and functional limitations in older adults, which concludes that there is a consistency in findings across studies and a range of outcome measures related to functional independence; regular aerobic activity and short-term exercise programs confer a reduced risk of functional limitations and disability in older age. In addition, a recently published literature review (Ross et al., 2013) inferred that cognitive and exercise interventions hold promise for maintaining everyday mobility, but conclusions regarding educational interventions on actual mobility outcomes were less clear. This review also concluded that future research should assess personalized interventions that take advantage of multiple constructs.

The immediate intervention group in the study also improved or maintained lean mass and quality of life and decreased weight, BMI and FM. After the 6-MTI, a decrease was found in weight, BMI, and waist circumference in the immediate intervention group. This is in line with other intervention studies (Bassuk & Manson, 2005). As Paper II identified, FM decreased by 5.3% and fat mass of the trunk by 6.4% in the immediate intervention group after 6-MTI. This confirms that regular exercise training and NC intervention can reduce weight and visceral fat accumulation (Ivy, 1997) and may therefore affect cardiometabolic risk factors (A. H. Taylor et al., 2004; Wallace, 2003).

There is evidence from high quality studies that strongly support the positive association between increased levels of PA, exercise participation and improved health in older adults (D. Taylor, 2014). The results from Paper I after 6-MTI showed that older adults have the capacity to increase muscle strength, and in Paper II an increase was found in the muscle mass after 6-MTI. Results that show improvements in muscle mass for this age group are uncommon, but nevertheless demonstrate and support Taylor's findings about the fact that PA is medicine for older adults (D. Taylor, 2014). An increase in strength could enable older adults to participate in exercise training, which can lead to improvements in the metabolic profile as well as improvements in physical function and endurance performance (Ferri et al., 2003; Sanz, Gautier, & Hanaire, 2010).

To answer the question about the long-term effects of the intervention, significant improvements were seen at 6- and 12-month follow-ups in the 8-foot up-and-go test and SPPB, but endurance and strength improvements were maintained as well as the gains in FFM and IQL. Although short-term randomized clinical trials in older persons have shown that structured PA programs improve performance on various measures of physical function, data are needed on long-term follow-ups (Binder et al., 2002; Nelson et al., 2004; Pahor et al., 2006). The results, particularly concerning performance on different measurements of physical function are not in line with many other studies that show significantly poorer follow-up measurements (Carvalho, Marques, & Mota, 2009; Toraman et al., 2004). In a recent study concerning 9-month long-term PA training programs and 3-month follow-ups, the subjects older than 74 years of age increased their FM in the follow-up measurements but maintained strength, endurance and flexibility (Seco et al., 2013). The results of 6- and 12-month follow-ups in the study clearly demonstrated how a MTI can improve functional fitness in older individuals, but also endurance and strength performance, decrease BMI and increase and maintain IQL in older individuals for relatively long periods of time.

A 6-month follow-up is covered in Paper II in connection with exercise training and NC on body composition and cardio-metabolic factors. A reduction in weight, BMI, and waist circumference was found during the 6-MTI, as did most intervention studies (Bassuk & Manson, 2005). At the 6-month follow-up by the immediate intervention group, FM and HDL increased, FFM, waist circumference, SBP, DBP and energy intake decreased compared to 6-MTI. It should be mentioned that the participants maintained strength and aerobic fitness, which is recognized to influence BP favorably (Wallace, 2003). At 6-month follow-up in the delayed intervention group, an increase was seen in SBP and TG, and a decrease in PA compared to 6-MTI. Other outcome measures were maintained compared to 6-MTI.

The reasons for the forenamed improvements are discussed in Paper I and may be due to three main reasons. First, the use of a reasonable and progressive training protocol with a desirable balance between the appropriate volume and intensity of the training sessions through the 6-MTI. Second, the ability of participants to follow the main goals of the study; to stay independent and carry on with PA after 6-MTI. Finally, the guidance part of the health instructors. Despite the improvements in most of the walked measureed, it is unfortunate that PA by some participants decreases after the MTI.

With regards to aim II, the evaluation of immediate and long-term effects (12-month follow-up) of a 6-MTI and NC on the variables, the main results were the positive and comparable effects on both sexes from the 6-MTI on physical performance, endurance and strength performance, body composition and PA. Impaired mobility, which can be measured with the 8-foot up-and-go test and SPPB-test, has a strong connection with weakness in the musculoskeletal system in the lower body, particularly muscle strength (Kwon et al., 2009). This weakness will increase the likelihood of falls by elderly people, but also contributes to compromised mobility and to disability (Guralnik et al., 1995; Kwon et al., 2009). The results of this study are interesting as they show comparable benefits for males and females with regards to mobility and dynamic balance after 6-MTI. In addition, the improvements are maintained at 12-month follow-up.

The SPPB test is partitioned in three tests; balance, chair rise and 4-meter walk (Guralnik et al., 1994a). Appealing to specialists and practitioners in this area (Guralnik et al., 1995; Kwon et al., 2009), who have investigated the meaning of changes in the score of the SPPB test, the results show sizable positive changes, both in the total score of the test, and also in the chair rise and the 4 meter walk. The chair rise, which measures the strength in the lower part of the body (Reid, Naumova, Carabello, Phillips, & Fielding, 2008), showed improvement among the males and females in the immediate intervention group but at the same time the males in the delayed intervention group performed worse in their 6-month control time (Paper III). But when the males in the delayed intervention group finished their delayed intervention, they improved in line with the immediate intervention group after their 6-MTI. This progress can be connected with the training intervention, particularly the RT part of the intervention, since studies have shown that muscle strength and muscle power have a correlation with the total score in the SPPB test and overall mobility (Hunter et al., 2004; Lambert & Evans, 2005; Reid et al., 2008; Visser et al., 2002).

The results from the 12-month follow-up are unusual compared with other studies. A similar study, which had a training duration of 7 months, showed similar results after the intervention period, but one month after completion of the intervention the effectiveness was lost (Teixeira-Salmela et al., 2005). It is hypothesized that the 4-meter walk in the SPPB test is a good instrument to analyze changes in the mobility of older individuals, besides it is an important predictor of ADL (Guralnik et al., 1995; Teixeira-Salmela et al., 2005). In the study, both males and females increased their walking speed after the 6-MTI. This result remained constant at the 6- and 12-month follow-ups.

Galvao and partners showed in their study that older women had more possibility to increase muscle strength than older men (Galvao, Newton, & Taaffe, 2006). This is in line with the results from Paper III, where there was a greater improvement in the thigh strength among the women. The lifestyle changes adopted during and after the 6-MTI, are likely to have had a considerable influence on these results, as discussed in Paper I.

Both males and females statistically increased their walking distance in the 6MW test equally. These results are confirmation that it is never too late to start training, and this confirmed that older people can increase their endurance by systematic training, independent of their sex (Huang, Shi, et al., 2005; Morikawa et al., 2011). The positive influence of an exercise intervention on mobility and general health is known, but also to minimize mortality, illness and disability through PA (T. J. Harris, Owen, Victor, Adams, & Cook, 2009). The results show a connection between the implementation of the training and increasing mobility in both sexes. The results show also that older men are more physically active than older women. This is line with other studies (Gardner & Montgomery, 2008; T. J. Harris et al., 2009). The results at the 12-month follow-up showed that there is no difference between the sexes anymore. The 6-MTI has most likely influenced their daily activity, particularly in the women.

In both males and females, BMI decreased after 6-MTI. This result remained constant through the entire research period. A study by Jenkins indicates that the higher the BMI is, the more likely it is for older persons to compromise their mobility (Jenkins, 2004), and hence, ADL will therefore be limited (Balzi et al., 2010). At the 12-month follow-up, the BMI was lower compared to baseline, strength was constant and mobility increased, therefore it is assumed that 6-MTI has a positive effect on general health and ADL in very old people.

With respect to the immediate and long-term effects of 6-MTI and NC on functional performance, body composition, endurance, strength, PA, energy intake and quality of life in three different elderly age groups, the results are in line with other results in the study. Any doubt over the possibility of improvement in the oldest group, 81 years and older, ought to be eliminated by examining the group according to different measurements compared with the other two younger groups. In the physical performance measurements the results are comparable in all groups, both after 6-MTI and also the overall effect at the 12-month follow-up, where improvements in all groups could still be seen.

The gain after 6-MTI is in line with other studies for these age groups (Marques et al., 2011; Serra-Rexach et al., 2011), but despite searching for studies for different age groups, no study could be found which had split elderly participants into different age groups as was done in the study. This separation into age groups is done for development and the validation of criterion-referenced clinically relevant fitness standards for maintaining physical independence in later years (Rikli & Jones, 2013). Therefore it is interesting to look at different age groups in the study and to see if the youngest age group had the highest rate of improvement but also if the oldest one had a similar or less gain than the other two younger age groups. These results are in line with the fact that progressive endurance and resistance training exercises promote an increase in muscle strength in older individuals and can have a positive effect on some functional limitations in older adults (Latham, Anderson, Bennett, & Stretton, 2003; Liu & Latham, 2009). At the 12-month follow-up the gains are still visible in all age groups and it has been difficult to find comparable results in other studies.

Improvement was also seen in the strength test of the thigh after the 6-MTI in all age groups. This result is different from a study which did not observe any significant changes in strength in subjects aged over 74 years after 9 months of training (Seco et al., 2013). At the 12-month follow-up, the improvement was still observable in the 71 to 75 age group, but had decreased, back to baseline, in the other two elderly groups.

It has been demonstrated that increasing peak aerobic capacity for walking by interval walking training is closely linked with decreasing indices of lifestyle-related diseases in middle-aged and older people (Morikawa et al., 2011). At the same time, it has also been found that the goal of combined endurance and resistance training may only be achieved by some older individuals (Karavirta et al., 2011). This is in line with the results of this study, where improvements were found in 6MW test in all age groups after 6-MTI, slightly less though in the oldest group but a statistical improvement was observable. At 12 months, the oldest group had a gain compared to baseline but had not statistically improved as much the other younger age groups did. This is almost in line with the PA measured by the accelerometers, where all groups had shown improvements after 6-MTI but the oldest age group went back to baseline, the youngest one had an improvement and the group 76 to 80 years of age also had a gain in their PA but it was not statistically significant.

It is interesting to see how the oldest group, with a mean age of 84, can obtain the same mean outcome as the other two groups, which are about 5–10 years younger. This was seen among other things in physical performance and the strength and endurance tests. This clearly shows what people are capable of doing although they have reached the age of 80 and over.

To respond to Aim V, i.e. to develop sustainable strategies that can by used by elderly people to meet international reccomendation of PA, the methods inthis study and the applied exercise training and NC intervention closely matched international PA recommendations that target older adults. (Chodzko-Zajko et al., 2009; Cunningham et al., 2013; Garber et al., 2011; Nelson et al., 2007; WHO, 2002). The recommendations from the ACSM and the American Heart Association concerning PA and public health for older adults describe the amounts and types of PA that promote health and prevent diseases (Nelson et al., 2007). The recommendation applies to all adults aged 65 and older, including among other things aerobic activity for a minimum of 30 minutes for five days each week or vigorous intensity aerobic activity for a minimum of 20 minutes on three days each week. They also include muscle-strength and muscle ET activity for a minimum of two days each week, where 8–10 exercises should be performed on two or more non-consecutive days per week using the major muscle groups. This is supported by flexibility activity to maintain or increase flexibility on at least two days each week for at least 10 minutes each day. Balance exercises should be performed to maintain or improve balance, but also to reduce the risk of injury from falls.

The study design and plan contained the aforementioned topics. In addition, there were seven lectures about health and nutrition designed to further strengthen the possibilities of developing sustainable strategies after the 6-MTI and to influence the lifestyle behavior and PA of the participants. The results are positive as shown in the published papers, but several of the findings highlight the need for longer term programs. An assessment of the cost-effectiveness of such a measure and other expenses is beyond the scope of this discussion, but the results nevertheless demonstrate that this type of simple program seems to be effective. A financial or economic analysis would be an interesting area for future research.

This study had several limitations. It is difficult to estimate whether the changes resulted from endurance or resistance exercise training, dietary habits or from all of these elements over the intervention period. Finally, because the study subjects were healthy old people, it may not be possible to generalize and to apply the present findings to older men and women with health problems. However, since the general elderly population is relatively healthy and the study intervention design is in line with physical activity recommendatory guidelines from the primary rehabilitation and health clinics in the world, most of the older individuals should obtain long-term health benefits from physical activity similar to the one in this intervention study.

6 Conclusions

This study clearly demonstrates that multimodal training intervention based on endurance, strength exercise and nutritional counseling is feasible and beneficial in a population of old people, particularly among those who have been physically inactive before. The results suggest that regular multimodal training intervention can affect and improve long-term retention of functional fitness for up to 12 months after the 6-month intervention. The training has an effect on functional fitness, endurance performance and can maintain strength performance and quality of life in this population. Moreover, the training affects cardiometabolic risk factors positively as it reduces FM, waist circumference and BP, and may increase HDL and FFM. Finally, the intervention may influence lifestyle behavior with regards to exercise.

Based on these results it suggest that regular multimodal training intervention may prevent functional decline in older individuals, influence lifestyle and enhance their independence and possibly reduce the need for institutional care. For societies and individual health practitioners it is therefore important to encourage all older persons to increase their PA and give them opportunities to participate in a supervised multimodal training program with the target to be sustainable in training and independent in activity of daily living.

7 Future perspectives

The proportion of the Icelandic population reaching retirement age is constantly rising (Andersen & Gudnason, 2012). In 2011, there were 5.8 Icelanders of working age, i.e. between 16 and 66 years of age, for every Icelander of retirement age, i.e. 67 and older. According to the Icelandic population projection there will be 3.0 people of working age for every pensioner in 2031 and 2.7 in 2051. This situation may represent a significant problem for Icelandic society because of increasing expenses in health care and the economy (Andersen & Gudnason, 2012).

Every country in the world also faces tremendous growth in chronic non-communicable diseases over the next few decades (WHO, 2006b, 2009, 2011). Diseases originating in unhealthy lifestyles might overburden public health care systems, bringing enormous health, social and economic consequences, unless creative new approaches to preserving health are identified and implemented by individuals and societies alike (Forum, 2011; WHO, 2006a). Societies need a proactive policy to reinforce health promotion and prevention policies throughout people’s lifespans, with a special emphasis on the older population (WHO, 2002).

An important goal of the current study was to establish that older people can increase their physical performance, strength and endurance capacity and have a positive influence on cardiovascular risk factors by participating in a systematic 6-MTI program. The question now is how these results can be disseminated and used to improve policy with regards to exercise in people above the age of 65. All stakeholders need to be activated, from the individual to society at large and preferably with the collaboration of the private and public sectors in order to improve the public health of the oldest populations in the future. The Icelandic state, local authorities and organizations should consider encouraging older adults to participate in physical activity and follow the Toronto Charter for Physical Activity (Bull et al., 2010). The charter outlines four action-based topics based on nine guiding principles. The principles are consistent with the non-communicable diseases action plan (Dean et al., 2013) and the Global Strategy on Diet, Physical Activity and Health (Fernstrom, Reed, Rahavi, & Dooher, 2012; Waxman, 2004) as well as other international health promotion charters (Bull et al., 2010). The state, local government and organizations are encouraged to:

- Adopt evidence-based strategies that target the whole population of older adults as specific population sub-groups, also those facing the greatest barriers.
- Establish and embrace an endowment fund aimed at reducing social and health inequalities and disparities of access to physical activity, such as accessibility to fitness centers, fitness programs and assistance from health instructors.
- Address the environmental, social and individual determinants of physical activity concerning older adults.
- Implement sustainable actions in partnerships at national, regional and local levels and across multiple sectors in the country to achieve a significant impact.
- Establish and build capacity and support training in education, research, practice, policy, evaluation and surveillance.
- Use a life-course approach by addressing the needs of older adults as with other groups in the community.
- Older adults campaign to decision-makers and the general community for an increase in political commitment to, and resources for, general physical activity.
- Ensure cultural sensitivity and adapt strategies to accommodate varying local realities, contexts and resources.
- Facilitate healthy personal choices by making the physically active choice the easy choice.

The first aspect should address the implementation of a national policy and action plan. This should provide direction, support and coordination for the many sectors involved. The plan should also assist in focusing resources as well as providing responsibility. A national policy and action plan should be a significant indicator of political commitment.

The second aspect should address the introduction of policies to support physical activity. A supportive policy framework should achieve sustainable changes in government and society. Policies that support health enhancing physical activity should be situated at national, regional and local levels. Both urban and rural planning policies and design guidelines should be observable and should, among other things, include and support walking, cycling, public transport, sport and recreation with a particular focus on equitable access and safety. A financial policy incorporating subsidies, incentives, tax deductions and the campaign Age-friendly cities of Europe (Green, 2013) could support participation in physical activity or taxation to reduce obstruction. This could be a tax incentive for physical activity equipment or club membership. It could also be a recreation policy and funding system that prioritize increased community participation by older individuals of the community. To engage PA on prescription could also be an option, as recent developments show from Sweden (Hendberg, Horder, & Ziden, 2014). Finally, engaging the media to promote increased political commitment to physical activity, for example regular newspapers article or discussion programs on the implementation of physical activity action to increase responsibility of participation.

The third aspect should address reorientation services and funding to prioritize physical activity in favor of health improving physical activity. Reorganizing services and funding systems can deliver multiple benefits including better health. This can also affect cost saving and greater social integration. An example could be physical activity programs that focus on a range of activities that maximize participation regardless of skill level and that focus on participation and enjoyment, creating opportunities for older people to be active at the fitness center while most of people are busy at work (Bull et al., 2010).

The fourth and last aspect for supporting a framework for action is to develop partnerships to encourage older people to participate in PA. Actions aimed at increasing population-wide participation in PA should be planned and implemented through partnerships and collaborations (Bull et al., 2010). Different sectors should be involved, as well as communities at national, regional and local levels. Successful partnerships can be developed by identifying common values and program activities. Examples of partnerships for action are, for example, government working groups to implement action plans, community initiatives involving different government departments and non-government agencies such as transport, urban planning, arts, education and health working together and sharing resources. It could also be coalitions of non-government organizations formed to lobby governments on the promotion of PA and also NC. It may also include national, regional or local partnership forums with key agencies from multiple sectors, universities, public and private stakeholders to promote programs and policies. And finally, it could be partnerships with population sub-groups including indigenous peoples, migrants and socially disadvantaged groups. A theory-driven policy assessment and policy-maker workshops might be an important means of scientific engagement in policy development for health promotion (Rutten et al., 2012).

The benefits of physical activity depend on accessibility and affordability, where not only national policymakers but also older individuals themselves must take the lead to create opportunities for improved aging through exercise and to lead a way towards more successful aging for future generations.

"Live long and prosper"

8 References

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Papers

Paper I

Paper I

Gudlaugsson et al. International Journal of Behavioral Nutrition and Physical Activity 2012, 9:107
http://www.ijbnpa.org/content/9/1/107

INTERNATIONAL JOURNAL OF BEHAVIORAL NUTRITION AND PHYSICAL ACTIVITY

RESEARCH **Open Access**

Effects of a 6-month multimodal training intervention on retention of functional fitness in older adults: A randomized-controlled cross-over design

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Abstract

Background: Older adults have the highest rates of disability, functional dependence and use of healthcare resources. Training interventions for older individuals are of special interest where regular physical activity (PA) has many health benefits. The main purpose of this study was to assess the immediate and long-term effects of a 6-month multimodal training intervention (MTI) on functional fitness in old adults.

Methods: For this study, 117 participants, 71 to 90 years old, were randomized in immediate intervention group and a control group (delayed intervention group). The intervention consisted of daily endurance and twice-a-week strength training. The method was based on a randomized-controlled cross-over design. Short Physical Performance Battery (SPPB), 8 foot up-and-go test, strength performance, six min walking test (6 MW), physical activity, BMI and quality of life were obtained at baseline, after a 6-month intervention- and control phase, again after 6-month crossover- and delayed intervention phase, and after anadditional 6-month follow-up.

Results: After 6 months of MTI, the intervention group improved in physical performance compared with the control group via Short Physical Performance Battery (SPPB) score (mean diff = 0.6, 95 % CI: 0.1, 1.0) and 8-foot up-and-go test (mean diff = −1.0 s, 95 % CI: -1.5, -0.6), and in endurance performance via 6-minute walking test (6 MW) (mean diff = 44.2 meters, 95 % CI: 17.1, 71.2). In strength performance via knee extension the intervention group improved while control group declined (mean diff = 55.0 Newton, 95 % CI: 28.4, 81.7), and also in PA (mean diff = 125.9 cpm, 95 % CI: 96.0, 155.8). Long-term effects of MTI on the particpants was assesed by estimating the mean difference in the variables measured between time-point 1 and 4: SPPB (1.1 points, 95 % CI: 0.8, 1.4); 8-foot up-and-go (−0.9 s, 95 % CI: -1.2, -0.6); 6 MW (18.7 m, 95 % CI: 6.5, 31.0); knee extension (4.2 Newton, 95 % CI: -10.0, 18.3); hand grip (6.7 Newton, 95 % CI: -4.4, 17.8); PA (−4.0 cpm, 95 % CI: -33.9, 26.0); BMI (−0.6 kg/m^2, 95 % CI: -0.9, -0.3) and Icelandic quality of life (0.3 points, 95 % CI: -0.7, 1.4).

Conclusions: Our results suggest that regular MTI can improve and prevent decline in functional fitness in older individuals, influence their lifestyle and positively affect their ability to stay independent, thus reducing the need for institutional care.

Trial registration: This study was approved by the National Bioethics Committee in Iceland, VSNb2008030014/03-1

Keywords: Physical activity, Functional fitness, SPPB, 6 MW, Strength, Cross-over design

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Background

Older adults have the highest rates of disability, functional dependence and use of healthcare resources, so effective interventions for older individuals are of special interest [1,2]. Regular physical activity (PA) has many health benefits for older people, contributing to a healthy and independent lifestyle and improvements in functional capacity, quality of life, and body composition [3-5]. Regular multimodal training, based on combined endurance and strength exercise, can also minimize the physiological effects of an otherwise sedentary lifestyle by reducing the development and progression of chronic disease and disabling conditions [6,7].

Several recent multimodal training studies have focused on the detraining effect where the outcome is a loss in performance with onset as soon as six weeks after training [8-10]. Others have reported follow-up results based on multimodal training intervention and how changes in PA behavior can influence older people´s lifestyles [11-13]. However, the current literature on multimodal training studies is conflicting in regards to individual responsibility, practical knowledge, and skills. Moreover, few have investigated how multimodal training programs can influence older people's long-term lifestyle [11-13].

To the best of our knowledge, few trials of randomized-controlled cross-over design using international recommendations with an emphasis on daily endurance and twice-a-week strength training [14], individual responsibility, practical knowledge, and skills have focused on 70–90 years old people for a 6-month extended follow-up. Therefore the main purpose of this training study was firstly to evaluate the long-term effects, 6 and 12 months following the completion of a 6-month multimodal training intervention (MTI) on functional performance, endurance performance via 6 minute walk test, strength, PA, BMI and Icelandic quality of life (IQL) in older persons, and secondly to analyze the short-term effects on outcomes after the completion of the intervention.

Methods

Study design

This study was a randomized, controlled, cross-over design, performed in Reykjavik, the capital area of Iceland. The trial was conducted in four phases (time-points): 1) Enrolment and the baseline assessment, where the participants were randomized into an immediate training intervention group (Group 1) and a delayed intervention group (Group 2), 2) the immediate intervention phase, where Group 1 underwent training for 6 months and Group 2 served as a control group, 3) the crossover- and delayed intervention phase in which participants in Group 2 received the same training intervention for 6 months as Group 1 received, which from that time-point did not receive any further intervention, and 4) additional 6-month follow-up without intervention (Figure 1). Outcome assessments occurred at the end of the immediate intervention and control phase, at the end of the crossover and delayed intervention phase, and after an additional 6 months follow-up phase.

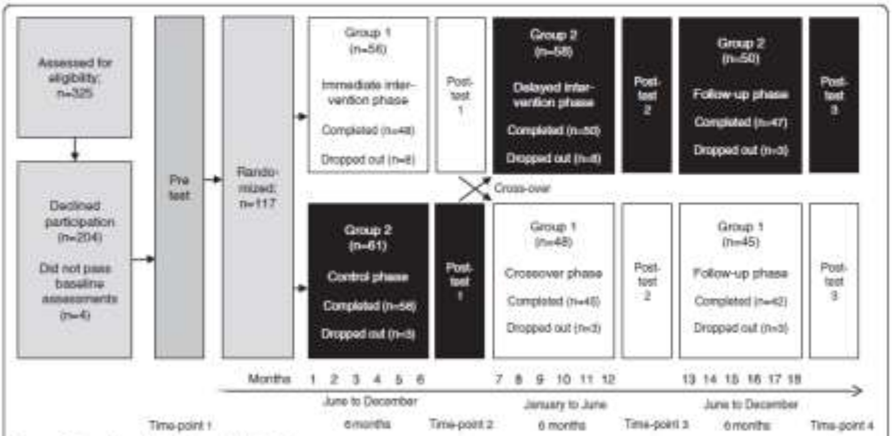

Figure 1 Flow of subjects through the trial.

Study participants

The participants were older individuals selected from the population-based Age, Gene/Environment Susceptibility – AGES Reykjavik Study [15] among individuals who were cognitive competent. Those who obtained a score of ≥23 points on the Mini Mental State Examination (MMSE) and ≥17 points on the Digit Symbol Substitution Test (DSST) were eligible for selection. Ninety-two of the 325 older individuals (>70), along with 25 spouses, accepted the invitation. Each participant in the trial had to fill out a questionnaire about his or her general health, and the information was reviewed by the study physician with regard to the safety of prescribed exercise. The Short Physical Performance Battery test (SPPB) [16] was also performed at screening, and a score of at least 7 points out of 12 on the test was required to be eligible for the study. The study was powered to detect a medium effect size (0.25 SD units) of any outcome measure with 80% probability, using ANCOVA to compare the post intervention measurements adjusting for baseline, not taking the clustering within groups into account. The sample size estimated was 100 at the end of the study period. We assumed a participation rate of 75% and due to the length of the study we assumed an attrition rate of about 20%.

Physical exercise intervention

The intervention consisted of a 6-month multimodal training, with an emphasis on daily endurance training and twice-a-week strength training. This was supported by seven lectures, three on nutrition and four on healthy aging, endurance, strength and how to train.

The endurance training consisted of daily walking over the intervention phase. The duration of the training session increased progressively through the 6-month training period. During the first week, the participants trained for 20 minutes at each session, and then the duration was increased systematically over the training period with two recovery weeks. The average duration per day was estimated at 34 minutes. In the first and last eight weeks, a health instructor was on site twice a week, but in weeks 9–18, only once a week. The training took place outdoors on a 400-meter running track, except for four weeks during the winter period when the training was indoors. Other endurance training sessions were self-administered with participants following the training intervention plan from the program. A health instructor was on site once to twice-a-week, but other endurance training sessions were self-administered with participants following a training plan, using the Karvonen formula to maintain and gradually increase the intensity [17]. During the first eight weeks, the intensity level was 50% of heart rate reserve (HRR), for the next 10 weeks it was increased to 60%, and during the last eight weeks it was approximately 70% of HRR. Every participant wore a Polar heart-rate monitor to maintain his or her individual target heart rate during the training.

Resistance training took place twice-a-week, on Tuesdays and Fridays, in a fitness centre, using the circuit series strength equipment from Life Fitness (Circuit Series Strength, Brunswick Corporation, USA), always under the guidance of health instructors. The strength training consisted of 12 exercises for all major muscle groups and was individually-based following a systematic training plan. The focus was on strength-endurance training for the first 3 months but for the latter 3 months it was on strength-power. The exercises for the lower body included leg press, leg extensions and calf raises. Exercises for the upper body included bench press, chest cross, shoulder press, pull downs, biceps curls, triceps extensions, and exercises for abdominal muscles and the back. For the first 2 weeks of strength-endurance training, the training program consisted of two sets of 12 repetitions (2x12) at 50% of one repetition maximum (1RM). Every two weeks, the working load was increased by two repetitions. The strength-endurance training was done in form of circuit training program, one set at each time. In the 13th week the repetitions were 18 in two sets. Recovery in form of light stretching between circuits was 3–4 minutes. In the second period, weeks 14 to 26, there program was changes from strength-endurance program to strength-power training program. The intensity went systematically from 10RM repetitions in the 14th week down to 6RM in the 24th week. The power training program consisted from the same 12 exercises as described before. The participants finished their exercise, two sets, with 1.5 minute rest between each set. The 9th and 18th week was organized as recovery weeks, with no strength training but 20 minutes endurance training every day.

Measurements

Baseline measurements were performed over a two week period before randomization. Outcome data for Group 1 was collected at the end of the immediate intervention phase, after the completion of the 6-month crossover phase, and after a 6-month follow-up phase. Outcome data for Group 2 were collected after the control phase, after the delayed intervention phase and after the completion of a 6-month follow-up phase. Demographic and clinical data was collected by trained research staff.

The SPPB [16] was used to measure physical performance but mobility and balance were measured by the 8-foot up-and-go test [18]. Maximal isometric muscle strength of the thigh and hand on the dominant side was measured with the participant in a sitting position in an adjustable dynamometer chair (Good Strength, Metitur, Palokka, Finland) [19]. Knee extension was measured with the knee angle at 60°, the ankle fastened by a belt to a strain-gauge system and with the participant's hands gripping the edge of the seat. Handgrip strength was measured with a dynamometer fixed to the arm of the same chair with the elbow flexed at 90°, using the same instructions and methods as for the lower limbs. Endurance performance was measured using the 6-minute walk test (6 MW) according to a standardized protocol [20]. The heart rate of participants was measured before and directly after completing the walk, and once more one minute later.

Total PA was assessed with Actigraph accelerometers (AG; Model 7164, version 2.2; ActiGraph Health Services, Fort Walton Beach, Florida, USA), which were programmed to record PA over one-minute intervals (60s epoch) [21]. The accelerometers were worn on the hip for six consecutive days, four week days and two weekend days, from the time the participant woke up until he or she went to sleep. Only data from monitors worn a minimum of eight hours per day, for at least two weekdays and one weekend day were included in the analysis. Average counts per minute (cpm) for these days measured by the accelerometer were calculated for each participant and were used to estimate PA level. A questionnaire was also used to estimate PA behavior in a typical week at each measurement time-point. During the training period, each participant had a 6-month intervention diary in which he or she had notes about suggested training regimens, but also confirmed their daily PA behavior as time spent on walking and strength training. The questionnaire and participant's diary were based on a Global Physical Activity Questionnaire [22].

Standing height was measured to the nearest 0.1 cm with a portable stadiometer (Seca 206, Seca Ltd, Birmingham, UK). Body weight was determined to the nearest 0.1 kg using a calibrated scale (Seca HV120, Seca Ltd, Birmingham, UK) with the participant in light clothing. Body mass index (BMI) was calculated as body mass (kg) divided by height squared (m^2).

The health-related quality of life (HRQL) was measured with a validated generic Icelandic instrument, Icelandic Quality of Life questionnaire (IQL). The IQL-test has norms for males and females in different age groups in order to evaluate individual deviation in HRQL. Five factors explain two thirds of the variance: general health (23.4%), mental well-being (20.5%), satisfaction (9.0%), sleep (6.9%), and finance (6.3%) [23].

Statistical analysis

Difference in each outcome at baseline and progression over time was analyzed using a repeated measures model with a first-order autoregressive covariance structure. A parameter was included in the model to represent each time-point for the immediate group (I), Group 1, and the delayed intervention group (D), Group 2: μ_{I1}, μ_{I2}, μ_{I3}, μ_{I4}, μ_{D1}, μ_{D2}, μ_{D3}, μ_{D4}. An adjustment was made for age and sex. The mixed models method allows for missing values in the response. All participants had at least a baseline measure and a measure after the intervention. Participants with missing values at other time–points were included in the analysis. Contrasts between time-points were estimated from linear combinations of the model parameters. For example: The difference between groups at baseline was estimated as $\mu_{I1} - \mu_{D1}$; the immediate intervention effect was estimated as $\mu_{I2} - \mu_{I1}$; the change between the repeat baseline and the baseline for the delayed intervention group was estimated as $\mu_{D2} - \mu_{D1}$; the delayed intervention effect as $\mu_{D3} - \mu_{D2}$; the overall intervention effect as $(\mu_{I2} - \mu_{I1} + \mu_{D3} - \mu_{D2})/2$; and the overall improvement completed follow-up phase by both groups (the difference between time-point 4 and time-point 1) as $(\mu_{I4} - \mu_{I1} + \mu_{D4} - \mu_{D1})/2$. The results were generated using the SAS MIXED model procedure in SAS/STAT software, version 9.2.

Results

Baseline characteristics and dropout

A diagram of subjects' flow through this randomized cross-over trial detailing the measurement phases is illustrated in Figure 1. Out of the 325 who were potentially eligible, 121 (37%) accepted the participation. The major reason for refusing participation in the study was too long and binding periods, not interested or because of spouse illness. Four participants out of the 121 did not pass the baseline assessments of the study. Thus, 117 subjects were randomized to the immediate intervention group (Group 1; n = 56) and delayed intervention group (Group 2; n = 61). A total of 48 subjects, 85.7% of those randomized for Group 1, completed the immediate intervention phase, and a total of 50 subjects, 82% of those randomized for Group 2, completed the delayed intervention. Overall, 98 subjects out of the 117 who were randomized received the entire 6-month training intervention. Reasons for attrition included spouse's illness or lack of time due to commitment to family. Significant differences at baseline characteristics were seen in age between the 98 subjects who completed the 6-month MTI (78.9 ± 4.5) and the 19 subjects who were randomized but did not complete the intervention (82.6 ± 3.5), in 8-foot up-and-go test (6.3 ± 1.2 seconds by MTI vs 7.4 ± 1.3 seconds; $p < .01$), and in strength, knee-extension (340.6 ± 94.3 Newton by MTI vs 273.6 ± 70.9 Newton; $p < .05$).

The baseline data for the characteristics of the study subjects randomized to Group 1 and Group 2 are

Table 1 Baseline characteristics of subjects randomized to immediate intervention (Group 1) and delayed intervention (Group 2)

	Immediate intervention	Delayed intervention (Control)	Difference between
	Group 1	Group 2	groups at baseline
Characteristic	(*n*) Mean±SD (Range)	(*n*) Mean±SD (Range)	*p*-value
Age	(56) 80.8±4.7 (73–90)	(61) 78.3±4.1 (71–88)	.003
Male (age)	(25) 81.9±4.8 (75–90)	(29) 79.0±4.3 (71–88)	.024
Female (age)	(31) 79.9±4.6 (73–89)	(32) 77.8±3.8 (72–85)	.045
Physical performance			
SPPB (points)	(56) 10.1±1.5 (7–12)	(61) 10.0±1.3 (7–12)	.168
Balance (points)	(56) 3.3±0.8 (2–4)	(61) 3.2±0.9 (1–4)	.167
Walk (seconds)	(56) 3.7±0.9 (2.3–8.4)	(61) 3.6±0.5 (2.7–4.9)	.549
Chair (seconds)	(56) 12.8±2.5 (7.7–18.0)	(61) 13.2±2.6 (8.4–20.0)	.177
8 foot up-and-go (seconds)	(56) 6.4±1.4 (4.4–13.2)	(61) 6.5±1.1 (4.4–9.7)	.217
Strength performance			
Knee extension (Newton)	(56) 328.4±96.3 (127.1–547.5)	(61) 330.9±92.5 (150.0–585.9)	.340
Hand grip (Newton)	(56) 311.0±96.8 (168.4–567.0)	(61) 341.9±108.4 (132.9–619.4)	.193
Endurance performance			
Six min walking (meter)	(56) 450.0±84.0 (255.0–656.0)	(61) 459.8±64.8 (300.0–612.0)	.592
Physical activity (cpm)	(39) 258.8±122.9 (100.0–589.0)	(44) 253.9±101.8 (106.0–537.0)	.275
BMI (kg/m^2)	(56) 27.6±5.3 (20.6–45.9)	(61) 27.4±3.4 (20.1–36.3)	.406
Icelandic Quality of Life (points)	(54) 55.7±5.5 (40–64)	(57) 55.9±5.1 (38–63)	.574

Values are shown as numbers in groups (*n*), means with standard deviation (SD) and range.
SD = Standard deviation.
SPPB = Short physical performance battery.
cpm = Average counts per minute.
BMI = Body mass index.

summarized in Table 1. The mean age was approximately 80 and the range 71–90. The only significant baseline difference between the two groups was in age, 80.8 ± 4.7 in Group 1 vs 78.3 ± 4.1 in Group 2.

The immediate intervention phase and the control phase

The results of the immediate intervention phase of the trial are presented in Table 2. There was a significant difference between the intervention and control groups in the changes for physical performance including better overall scores for the SPPB (mean diff = 0.6, $p < .05$) and chair rises (mean diff = −1.8 s, $p < .001$), in mobility and balance by the 8-foot up-and-go test (mean diff = −1.0 s, $p < .001$), in knee extension strength (mean diff = 55.0 Newton, $p < .001$) and in endurance by the 6-minute walking test (mean diff = 44.2 m, $p < .001$). There were also significant increases in daily PA (mean diff = 125.9 cpm, $p < .001$) between the groups where the immediate intervention group increased their PA around 13% while at the same time the delayed intervention group showed a 14% decrease. Significant changes between baseline and MTI within the immediate intervention group was seen on all measurements apart from balance part in the SPPB and IQL.

The crossover and delayed intervention phase

The results of the crossover phase of the trial are presented in Table 3. Group 2 had improvements in their delayed intervention (Table 3, column 6) comparable to the immediate intervention of Group 1 (Table 2, column 3). In addition, all gains seen in the immediate intervention by Group 1 were maintained over the following 6-month period where there was no formal training on behalf of the health educators (Table 3, column 3).

Multimodal training intervention phase by both groups together

The effects of MTI in all 98 subjects in both Group 1 and Group 2 who completed the intervention are pooled together and summarized in Table 4. All changes in all measurements were statistically significant except for the balance test in SPPB. This may have represented a ceiling effect because approximately 58% of the subjects obtained 4 points or the maximum results from this test.

Figure 2a–c demonstrates outcome measures at four time-points and MTI overall effect from both groups in long-term improvements in 8-foot up-and-go (mean diff = −0.9, $p < .001$) and 6 MW (mean diff = 18.7 m, $p < .01$), but strength performance measured as knee extension

Gudlaugsson et al. International Journal of Behavioral Nutrition and Physical Activity 2012, 9:107
http://www.ijbnpa.org/content/9/1/107

Table 2 Outcomes for subjects who completed the immediate intervention phase and the control phase, and between-group differences

	Group 1 (Immediate intervention phase) (n=48)			Group 2 (Control phase) (n=58)			Between-group
Outcome and Values	Baseline	MTI	Change	Baseline	Rep. Base	Change	difference
	Mean (SE)	Mean (SE)	Diff in means (95% CI)	Means (SE)	Means (SE)	Diff in means (95% CI)	Diff in means (95% CI)
Physical performance							
SPPB (points)	10.1 (0.2)	10.7 (0.2)	0.6 (0.2 to 0.9)***	9.8 (0.2)	10.1 (0.2)	0.3 (0.0 to 0.6)	0.6 (0.1 to 1.0)*
Balance (points)	3.4 (0.1)	3.4 (0.1)	0.1 (-0.2 to 0.3)	3.2 (0.1)	3.2 (0.1)	0.1 (-0.2 to 0.3)	0.2 (-0.1 to 0.5)
Walk (seconds)	3.7 (0.1)	3.3 (0.1)	-0.3 (-0.5 to -0.2)***	3.6 (0.1)	3.4 (0.1)	-0.2 (-0.3 to -0.1)**	-0.1 (-0.2 to 0.1)
Chair (seconds)	12.7 (0.3)	11.0 (0.3)	-1.7 (-2.2 to -1.2)***	13.3 (0.3)	12.8 (0.3)	-0.5 (-1.0 to -0.1)*	-1.8 (-2.7 to -0.8)***
8 foot up-and-go (seconds)	6.3 (0.2)	5.7 (0.2)	-0.6 (-0.9 to -0.3)***	6.6 (0.2)	6.7 (0.2)	0.1 (-0.2 to 0.4)	-1.0 (-1.5 to -0.6)***
Strength performance							
Knee extension (Newton)	338.8 (9.3)	367.3 (9.7)	28.5 (15.3 to 41.7)***	326.2 (9.1)	312.3 (9.2)	-13.9 (-26.0 to -1.9)*	55.0 (28.4 to 81.7)***
Hand grip (Newton)	323.1 (8.6)	334.4 (8.8)	11.3 (1.4 to 21.2)*	339.0 (8.4)	343.1 (8.5)	4.1 (-4.8 to 13.1)	-8.8 (-33.1 to 15.6)
Endurance performance							
Six min walking (meter)	457.0 (9.6)	491.1 (9.8)	34.2 (23.3 to 45.0)***	449.7 (9.3)	447.0 (9.4)	-2.7 (-12.5 to 7.1)	44.2 (17.1 to 71.2)**
Physical activity (cpm)	272.9 (16.9)	307.1 (15.7)	34.2 (0.8 to 67.6)*	247.0 (16.1)	211.7 (15.0)	-35.2 (-66.2 to -4.3)*	125.9 (96.0 to M155.8)***
BMI (kg/m^2)	27.7 (0.6)	27.3 (0.6)	-0.5 (-0.7 to -0.3)***	27.0 (0.6)	26.9 (0.6)	-0.2 (-0.4 to 0.0)	0.4 (-1.2 to 2.0)
Icelandic quality of life (points)	55.8 (0.7)	56.6 (0.7)	0.7 (-0.2 to 1.7)	55.3 (0.7)	54.6 (0.7)	-0.6 (-1.5 to 0.3)	1.9 (-0.1 to 3.9)

Values are shown as means with standard error (SE) at following time points: baseline and MTI by Group 1 and baseline and repeated baseline by Group 2, 95% confidence interval in means (95% CI) comparing changes between groups, and significant differences; * $p < .05$, ** $p < .01$, *** $p < .001$.
MTI = Multimodal Training Intervention.
Rep. Base = Repeat Baseline.
SE = Standard error.
SPPB = Short physical performance battery.
cpm = Average counts per minute.
BMI = Body mass index.

maintained (mean diff = 4.2 Newton, $p > .05$) compared to baseline. MTI overall effects in other measurements was following: Balance within SPPB (mean diff = 0.2 s, $p < .05$), 4 m walking within SPPB (mean diff = –0.7 s, $p < .001$), chair rises within SPPB (mean diff = −2.7 s, $p < .001$), hand grip (mean diff = 6.7 Newton, $p > .05$), IQL (mean diff = 0.3, $p > .05$), daily PA (mean diff = −4.0 cpm, $p > .05$) and BMI (mean diff = –0.6, $p < .001$).

Physical activity behavior

Figure 3a–c illustrates distribution of time spent in daily PA behavior (%) in terms of walking-days, walking-duration and strength training sessions per week by both groups together during four periods; the period before baseline by Group 1 and delayed baseline by Group 2 (period A); during the immediate intervention by Group 1 and delayed intervention by Group 2 (period B); during the crossover by Group 1 and follow-up 1 by Group 2 (period C); and during follow-up 2 by Group 1 (period D). During period A, approximately half of the participants had none or just one walking day per week and about 60% estimated that their walking duration per session was less than 15 minutes. The participation in strength training during this period was about 10%. Period B shows the PA behavior over the 6-month immediate and delayed intervention. During period C, 90% of the participants reported that they had two or more walking days per week, 72% said that they spent from 16 and up to 75 minutes in every walking session, and 43% said they performed strength training on a regular basis, generally twice a week. Comparable outcomes during period D in walking days and minutes in walking sessions were measured by Group 1, but 55% of the group informed that they participated in strength training on a regular basis.

Discussion

This study resulted in notable significant improvements in functional performance, strength, endurance via 6 MW, PA, BMI and IQL among older individuals. At the crossover phase and follow-ups they retained their improvements above baseline status despite some attenuation in strength, IQL and PA. Furthermore, substantially positive changes were seen in participant's lifestyle changes in daily PA behavior, both in endurance and strength training at crossover and follow-up phases. Results from this study clearly demonstrate that well

Gudlaugsson et al. International Journal of Behavioral Nutrition and Physical Activity 2012, 9:107
http://www.ijbnpa.org/content/9/1/107

Table 3 Outcomes for subjects who completed the crossover and delayed intervention phase, and between-group differences

	Group 1 (No Intervention) (n=45)			Group 2 (Delayed Intervention) (n=50)			Between-group
Outcome and Values	MTI	Crossover	Change	Rep. Base	Delayed MTI	Change	difference
	Mean (SE)	Mean (SE)	Diff in means (95% CI)	Means (SE)	Means (SE)	Diff in means (95% CI)	Diff in means (95% CI)
Physical performance							
SPPB (points)	10.7 (0.2)	11.0 (0.2)	0.3 (0.0 to 0.7)	10.1 (0.2)	10.7 (0.2)	0.6 (0.2 to 0.9)***	−0.3 (−0.8 to 0.2)
Balance (points)	3.4 (0.1)	3.5 (0.1)	0.0 (−0.2 to 0.3)	3.2 (0.1)	3.4 (0.1)	0.1 (−0.1 to 0.4)	−0.1 (−0.4 to 0.2)
Walk (seconds)	3.3 (0.1)	3.3 (0.1)	0.0 (−0.2 to 0.1)	3.4 (0.1)	3.3 (0.1)	−0.1 (−0.2 to 0.1)	0.0 (−0.2 to 0.3)
Chair (seconds)	11.0 (0.3)	10.4 (0.3)	−0.6 (−1.1 to −0.1)*	12.8 (0.3)	11.5 (0.3)	−1.3 (−1.8 to −0.8)***	1.0 (0.1 to 2.0)*
8 foot up-and-go (seconds)	5.7 (0.2)	5.6 (0.2)	−0.1 (−0.4 to 0.2)	6.7 (0.2)	6.0 (0.2)	−0.7 (−1.0 to −0.4)***	0.4 (−0.1 to 0.9)
Strength performance							
Knee extension (Newton)	367.3 (9.7)	355.7 (9.9)	−11.6 (−25.0 to 1.7)	312.3 (9.2)	343.6 (9.6)	31.3 (18.6 to 44.0)***	−12.1 (−39.4 to 15.2)
Hand grip (Newton)	334.4 (8.8)	335.4 (9.0)	1.1 (−9.0 to 11.1)	343.1 (8.5)	357.5 (8.7)	14.3 (4.9 to 23.8)**	22.0 (−2.9 to 46.9)
Endurance performance							
Six min walking (meter)	491.1 (9.8)	481.1 (10.0)	10.0 (−21.3 to 1.3)	447.0 (9.4)	462.8 (9.7)	15.8 (5.3 to 26.3)**	−18.3 (−46.0 to 9.5)
Physical activity (cpm)	307.1 (15.7)	277.1 (16.4)	−30.1 (−60.7 to 0.6)	211.7 (15.0)	337.6 (16.0)	125.9 (96.0 to 155.8)***	60.6 (15.1 to 106.0)**
BMI (kg/m^2)	27.3 (0.6)	27.3 (0.6)	0.0 (−0.2 to 0.2)	26.9 (0.6)	26.4 (0.6)	−0.5 (−0.7 to −0.3)***	−0.9 (−2.5 to 0.8)
Icelandic quality of life (points)	56.6 (0.7)	56.2 (0.7)	−0.4 (−1.4 to 0.6)	54.6 (0.7)	55.5 (0.7)	0.9 (−0.1 to 1.8)	−0.6 (−2.7 to 1.4)

Values are shown as means with standard error (SE) at following time points; MTI and crossover by Group 1 and repeated baseline and delayed MTI by Group 2, 95% confidence interval in means (95% CI) comparing changes between groups, and significant differences; * $p < .05$, ** $p < .01$, *** $p < .001$.
MTI = Multimodal Training Intervention.
Rep.Base = Repeat Baseline.
SE = Standard error.
SPPB = Short physical performance battery.
cpm = Average counts per minute.
BMI = Body mass index.

organized longitudinal multimodal training intervention can improve several physiological as well as psychological factors for relatively long periods among old people.

Age-related trends within studies were remarkably similar and even though the sexes differ in levels of physical fitness, the observed age differences was similar within a given population [24]. The effects from the training intervention in our study showed statistically improvements in functional performance, endurance via 6 MW and strength, PA, BMI and IQL. Similar positive health-related changes have been shown in several other studies [3,4,10-13].

In this study the participants were older and the training intervention and follow-up periods was longer than in most existing multimodal studies of PA that we compare to [4,8,9]. Our training design very clearly met the minimum standards recommended in guidelines for older individuals, both in the endurance and strength parts of the study [6,25]. Generally, other multimodal training studies satisfied the strength part of recommendations, but not the endurance part, which results in smaller comprehensive improvements [10,11,13,26]. For example, the results from body composition in our study showed that older subjects were able to achieve a decrease in BMI after six months of training, but at the same time enhance their strength. Similar results between this study and the findings of others were seen for gait speed, where functional decline was observed one month after the cessation of training [11].

The frequency, duration, and intensity employed in this study may have contributed to the improvement in 6 MW after the MTI. But the reason for the maintenance at crossover and follow-ups measurements lies arguably in lifestyle changes and self-organized training by the participants after the intervention period. A study [10] with training sessions twice per week showed clearly that this is not enough stimulus for measurable improvements as was evident in our study. Our intervention methods, with about 240 minutes per week of moderate-intensity exercise for six months, met the recommended 150 minutes per week of moderate-intensity aerobic activity, for the elderly [6].

These results also underline the importance for older people to participate in regular training for their quality of life [12]. To the knowledge of the authors of the current study, few studies were available where 6-month multimodal training with 6- and 12-month follow-ups has been performed for this age group. In most prior studies, the participants were younger, had significantly

Gudlaugsson et al. International Journal of Behavioral Nutrition and Physical Activity 2012, 9:107
http://www.ijbnpa.org/content/9/1/107

Table 4 Outcomes for all subjects who completed MTI in both groups

Outcome and Values	Baseline Repeated baseline	Completed MTI (n=98) Immediate MTI Delayed MTI	Change
	Means (SE)	Means (SE)	Diff in means (95% CI)
Physical performance			
SPPB (points)	10.2 (0.1)	10.7 (0.1)	0.6 (0.3 to 0.8)***
Balance (points)	3.3 (0.1)	3.4 (0.1)	0.1 (−0.1 to 0.3)
Walk (seconds)	3.5 (0.1)	3.3 (0.1)	−0.2 (−0.3 to −0.1)***
Chair (seconds)	12.6 (0.2)	11.1 (0.2)	−1.5 (−1.8 to −1.1)***
8 foot up-and-go (seconds)	6.4 (0.1)	5.7 (0.1)	−0.6 (−0.8 to −0.4)***
Strength performance			
Knee extension (Newton)	332.2 (7.2)	360.8 (7.2)	28.6 (18.7 to 38.5)***
Hand grip (Newton)	336.0 (6.4)	349.0 (6.4)	13.0 (5.8 to 20.2)***
Endurance performance			
Six min walking (meter)	457.5 (7.5)	482.4 (7.5)	24.9 (17.2 to 32.6)***
Physical activity (cpm)	240.3 (12.2)	326.0 (11.6)	85.6 (62.2 to 109.1)***
BMI (kg/m^2)	27.3 (0.5)	26.8 (0.5)	−0.46 (−0.6 to −0.3)***
Icelandic quality of life (points)	55.6 (0.5)	56.4 (0.5)	0.8 (0.1 to 1.5)*

Values are shown as means with standard error (SE) at following time points pulled together: baseline by Group 1 and repeated baseline by Group 2, and immediate MTI by Group 1 and delayed MTI by Group 2, and as 95% confidence interval in means (95% CI) comparing changes for all subjects who completed MTI, and significant differences; * $p < .05$, ** $p < .01$, *** $p < .001$.
MTI = Multimodal training intervention.
SE = Standard error.
SPPB = Short physical performance battery.
cpm = Average counts per minute.
BMI = Body mass index.

worsened at the follow-up measurements, and were even worse after one year of follow-up compared to their baselines [9,10]. Overall MTI outcomes in our study generally remained statistically better compared to baseline, and none were statistically lower. These long-term positive results are likely to have three main reasons. First, the use of reasonable and progressive training protocol with a desirable balance between the appropriate volume and intensity of the training sessions throughout the whole intervention period. Secondly, the ability of the participants to follow the main goals of this study: to stay independent and carry on with the PA after the MTI, and finally, the guidance part by health instructors, both in educating and encouraging the participants in their work. The validity of the last point needs further examination. In addition, the exercise program after MTI could be continued by the participants with less support from a health instructor. Instead of twelve to sixteen exercise sessions with a health instructor per month, we would recommend, based on our findings, two to four sessions with a health instructor per month, in addition, independent PA, to maintain endurance and strength.

This multimodal training intervention study had 6 and 12 months follow-up time-points. The results clearly demonstrated that this multimodal training program improved endurance as well as strength performance, decreased BMI and increased and maintained IQL in older individuals for a relatively long period of time. Hence, this type of training could have a clinically relevant impact on older individuals in the general population if applied to a large number of individuals. The use of educated health instructors during the training intervention and working closely with the people might help to maintain their performance after the formal training period. Such implementation seems to motivate and support older individuals who seek to maintain their physical health and IQL on their own over a long period of time. This was strongly supported by the observation that about 60% of the participants estimated that their walking duration per session was less than 15 minutes before they entered the study. On the other hand, about 90% had two to seven walking days per week, whereof over 70% said that they spent from 16 and up to 75 minutes in every walking session for up to a year after the training intervention.

This study had several strengths that address some of the limitations of previous multimodal training studies. Our objective was to influence participants' lifestyles and everyday activities during the MTI, with a focus on individual responsibility and to prepare the participants to train independently after completing the immediate or

Gudlaugsson et al. International Journal of Behavioral Nutrition and Physical Activity 2012, 9:107
http://www.ijbnpa.org/content/9/1/107

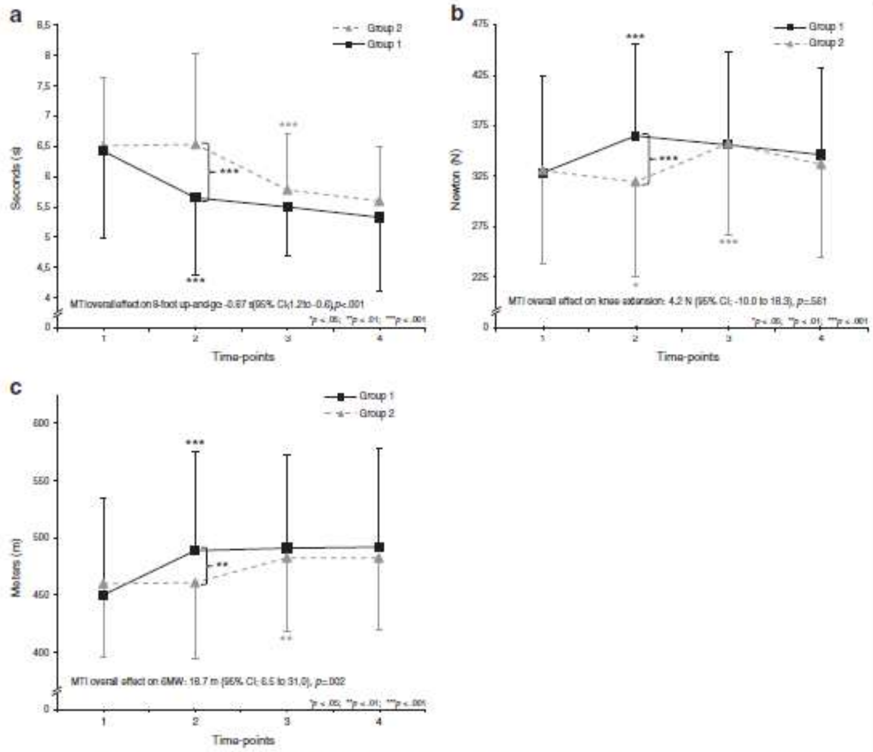

Figure 2 a Outcome measures from Group 1 and Group 2 in the 8-foot up-and-go test at four time-points: At baseline (1); after 6-month immediate intervention and control phase (2); after completed crossover phase and delayed intervention phase (3); after completed follow-up 2 phase by Group 1 and follow-up 1 phase by Group 2 (4). 2b Outcome measures from Group 1 and Group 2 in knee-extension strength performance test at four time-points: At baseline (1); after 6-month immediate intervention and control phase (2); after completed crossover phase and delayed intervention phase (3); after completed follow-up 2 phase by Group 1 and follow-up 1 phase by Group 2 (4). **2c** Outcome measures from Group 1 and Group 2 in 6 MW endurance performance test at four time-points: At baseline (1); after 6-month immediate intervention and control phase (2); after completed crossover phase and delayed intervention phase (3); after completed follow-up 2 phase by Group 1 and follow-up 1 phase by Group 2 (4).

the delayed intervention phase. Our training was based on international recommendations [27] and the methods and philosophy were similar to those that would be used in a sedentary population, with few allowances for age. The use of accelerometers to assess physical activity volume and intensity and the low dropout rate for this age-group can be classified as strength of this study.

Conclusions

In conclusion, this study clearly demonstrates that multimodal training intervention based on endurance and strength exercise is feasible and beneficial in older populations, particularly among those who have not been physically active before. Our results suggest that regular MTI can affect and improve long-term retention, 12 and 18 months after the baseline measurements, of functional fitness and endurance performance measured by 6 MW and maintain strength performance and quality of life in old people. In addition, the intervention can influence the lifestyle behavior concerning strength and endurance training. Therefore, we suggest that regular MTI can prevent

Gudlaugsson *et al. International Journal of Behavioral Nutrition and Physical Activity* 2012, **9**:107
http://www.ijbnpa.org/content/9/1/107

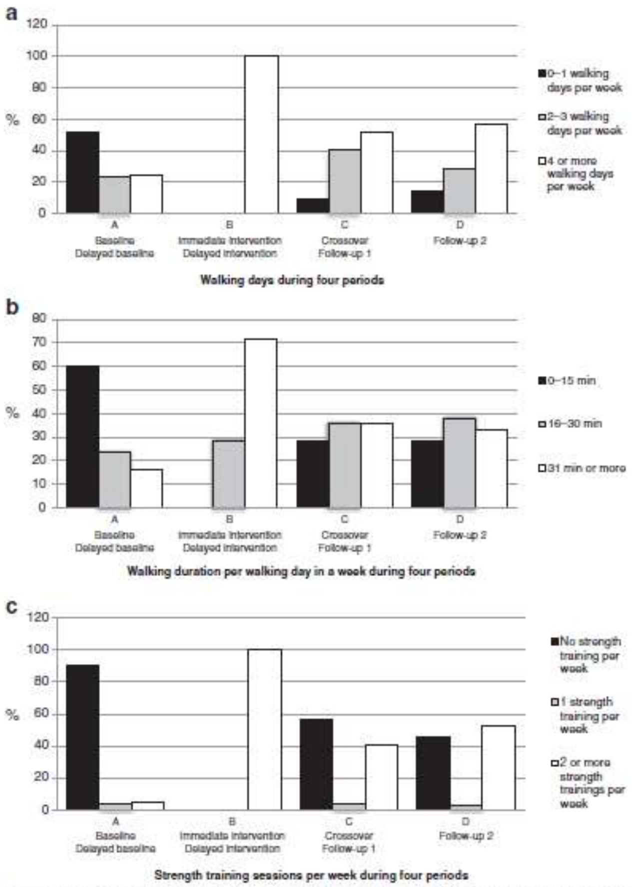

Figure 3 a Distribution of participation spent in physical activity, walking days in a week (%), during following four periods for both groups: During the period before baseline and delayed baseline (A), during immediate intervention and delayed intervention (B), during crossover and follow-up 1 (C) and during follow-up 2 by Group 1 (D). 3b Distribution of participation spent in physical activity, walking duration per walking day in a week (%), during following four periods for both groups: During the period before baseline and delayed baseline (A), during immediate intervention and delayed intervention (B), during crossover and follow-up 1 (C) and during follow-up 2 by Group 1 (D). **3c** Distribution of participation spent in physical activity, strength training sessions per week (%), during following four periods for both groups: During the period before baseline and delayed baseline (A), during immediate intervention and delayed intervention (B), during crossover and follow-up 1 (C) and during follow-up 2 by Group 1 (D).

decline in functional fitness in old people, influence their lifestyle and positively affect their ability to stay independent; thus reducing the need for institutional care. For societies and individual health practitioners it is therefore important to encourage all older persons to increase their PA and give them opportunities to participate in a supervised multimodal training program.

Abbreviations

PA: Physical activity; MTI: Multimodal training intervention; SPPB: Short Physical Performance Battery; IQL: Icelandic quality of life; HRQL: The health-related quality of life; BMI: Body mass index; 6 MW: 6-minute walk test.

Competing interests

The authors declare that they have no competing interest.

Authors' contributions

All authors were involved in the study concept and design, and in obtaining funding. JG, EJ, and VG were involved in the acquisition of data, and JG, EJ, SAA, ASO, TH, KS, VG, TA, and PVJ were involved in analysis and interpretation of data. All authors drafted the manuscript and critically revised it for important intellectual content. All authors read and approved the final manuscript.

Acknowledgments

We thank all participants for their understanding and cooperation. We thank the research team at the University of Iceland and, especially the Master's Students that contributed in the data collection and the research colleague at the National Institute of Aging in Bethesda, USA.

Funding

This research project was supported by The Icelandic Centre for Research, The University of Iceland Research Fund, The Ministry of Education, Science and Culture Sport Fund, The Association of Municipalities in the Capital Area, The Fitness Centre Laugar, The Public Health Institute of Iceland and The Icelandic Heart Association.

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Received: 21 October 2011 Accepted: 4 September 2012
Published: 10 September 2012

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doi:10.1186/1479-5868-9-107
Cite this article as: Gudlaugsson *et al.*: Effects of a 6-month multimodal training intervention on retention of functional fitness in older adults: A randomized-controlled cross-over design. *International Journal of Behavioral Nutrition and Physical Activity* 2012 9:107.

Paper II

Paper II

European Geriatric Medicine 4 (2013) 431–437

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Specific care programme for the elders

Effects of exercise training and nutrition counseling on body composition and cardiometabolic factors in old individuals

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ARTICLE INFO

Article history:
Received 10 June 2013
Accepted 11 September 2013
Available online 11 October 2013

Keywords:
Physical activity
Body composition
Cardiometabolic factors
Exercise training and nutrition counseling
Older people

ABSTRACT

Background: Regular physical activity (PA) and nutritional counseling can reduce weight and trunk fat accumulation and influence cardiometabolic factors.
Methods: This study was an exercise training and nutritional counseling intervention, conducted in two 6-month phases. Participants were assessed at baseline and at 6 and 12 months. Participants (54 males and 63 females aged 71–90) were randomized into immediate exercise training group (Group 1) and delayed exercise training group (Group 2). At time-point 2, the groups crossed over.
Results: After the exercise training-phase by Group 1, a statistically significant increase ($P < 0.05$) was seen in physical activity (PA), energy intake, and total lean mass. A significant decrease was seen in weight, total fat mass, trunk fat mass, waist circumference, and blood pressure. At the 6-month follow-up, Group 1 saw a significant decrease in PA, energy intake, total lean mass and blood pressure. A significant increase was seen in waist circumference and total fat mass. After the 6-month control phase by Group 2, a significant decrease was measured in PA, systolic blood pressure, total fat mass, fat mass of the trunk and waist circumference. After a delayed 6-month exercise training-phase by Group 2, a significant increase was measured in PA, and a decrease in weight, total fat mass, trunk fat mass, waist circumference, blood pressure and triglyceride.
Conclusion: Our findings suggest that positive improvements in body composition and cardiometabolic factors in old people may be achieved by systematic exercise training in combination with nutrition counseling. This should be considered as an integral part of the health care system.

1. Introduction

Intervention studies that include physical activity (PA) have decreased weight, visceral fat accumulation and are very effective in the prevention and treatment of cardiometabolic risk factors [1,2]. Exercise training has been shown to be effective in increasing high-density lipoprotein cholesterol (HDL), decreasing triglyceride (TG) levels and blood pressure (BP) [3]. These changes often take place independently of weight loss, but how much of the beneficial outcome is independent of weight loss and changes in body composition is not entirely clear [4].

The metabolic syndrome is characterized by numerous factors connected with cardiometabolic risk factors [5]. The syndrome is strongly linked to coronary heart disease, type 2 diabetes and, more generally, increased mortality [6]. Epidemiological studies have documented that the metabolic syndrome occurs commonly in middle-aged people and that there is a higher frequency in men and among older individuals [7]. The diagnosis and treatment of underlying risk factors for the metabolic syndrome should be an important strategy for the reduction of all-cause mortality associated with cardiometabolic risk factors in the general population [8].

Regular PA reduces the risk of cardiometabolic risk factors including high blood pressure, and diabetes [9]. Approximately 3.2 million people die each year due to physical inactivity but people who are insufficiently physically active have a 20–30% increased risk of all-cause mortality [9]. Moderate and vigorous physical activities are associated with positive changes in body composition and reduced risk of being classified with cardiometabolic risk factors, independently of age [10,11].

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http://dx.doi.org/10.1016/j.eurger.2013.09.005

The ultimate goal of public health research is to create and communicate scientific knowledge so the general population can make better choices about its food intake and lifestyle, so as to achieve and maintain good health throughout the life span [12]. The purpose of this study was to evaluate the effects of 6 months of exercise training and nutritional counseling on body composition and cardiometabolic risk factors in older people and a control group.

2. Methods

2.1. Study design

This study was a randomized trial, conducted in Reykjavik, Iceland. The trial was conducted in two 6-month intervention phases after enrollment with baseline assessments prior to the start of the study (time-point 1). Outcome assessments were performed at the end of the first intervention phase (time-point 2) and at the end of the second (delayed) intervention phase (time-point 3). Details about the study design have been described previously [13].

2.2. Study participants

The participants in this study were 117 individuals aged 71–90 years, 54 males and 63 females, drawn from the population-based Age, Gene/Environment Susceptibility – AGES Reykjavik Study [14]. Details about the characteristics of the participants have been described previously [13]. This study was approved by the National Bioethics Committee in Iceland (VSNb20080300114/03-1) and all participants gave written informed consent.

2.3. Intervention strategy

The intervention consisted of a 6-month exercise training program, with the emphasis on daily endurance training and strength training twice a week. This was supported by three short lectures on nutrition and four lectures on healthy aging, endurance and strength training. Physical activity has been defined as any bodily movement produced by skeletal muscles that results in energy expenditure, while exercise, a subset of physical activity, is physical activity that is planned, structured, repetitive and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective [15]. Lectures were held in the 1st, 4th, 12th and the 22nd week of the intervention phase. Each session was around 45 minutes.

The endurance training consisted of daily walking, which gradually increased from 20 minutes to 45 minutes during the intervention phase. The strength training took place twice a week and consisted of 12 exercises for all major muscle groups. For the first 3 months the focus was on strength endurance training and in the latter 3 months on strength power. A health instructor was on site once or twice a week for the endurance training but always on site for the strength training. The intervention has been described in detail previously [13].

Both groups were asked to fill out a 3-day food record at all time-points. All participants received detailed instructions on how to describe their food intake accurately according to household measurements and/or standard portion sizes. They were asked to record all foods and drinks consumed for three consecutive days, either from Thursday to Saturday or from Sunday to Tuesday. The three nutrition lectures during the exercise training-phase were based on information on dietary habits for this age group from the National Nutrition Survey in 2002 and food-based dietary recommendations from the Icelandic Public Health Institute [16]. Furthermore, Group 2 also received two short individual counseling interviews and two sessions of hands-on training in a kitchen during their 6-month exercise training session.

2.4. Nutrition counseling

Both groups were informed and provided with a referral letter from the practitioners of the study to attend counseling sessions about diet and nutrition. All participants received three motivational lectures on nutrition during the training-phase. The first lecture was about the importance of vegetable and fruit consumption, whole grain bread and other cereal rich in fiber, low-fat dairy products, cod-liver oil or other vitamin D supplements and water. The second lecture started with a revision of the first session, but mainly aimed at putting proper proportions and amounts of foods on the plate; fish, meat and another kind of meals were discussed, salt consumption, and use of oil and soft fat instead of hard fat were emphasized. The third and last nutrition lecture during the intervention phase started with a recap of the first two lectures, but also covered the importance of healthy bodyweight, the importance of eating healthily while on vacation and how the presentation of food influences eating behaviour. Lectures were held in the 4th, 12th and the 22nd week of the intervention phase. Group 2 also received two 10-minute individual nutrition counseling visits and two group sessions of hands-on training in a kitchen during their 6-month exercise training session. These sessions had the same focus as the aforementioned lectures.

2.5. Outcome measurements

Baseline measurements, demographic and clinical data were collected by trained research staff as previously described [13]. Whole-body composition was measured using Dual energy X-ray absorptiometry, GE Lunar, iDXA Software 11.40.004 from GE Healthcare, Madison, WI [17].

The definition of metabolic syndrome used was that provided by the National Cholesterol Education Program [18] and was comprised of elevated levels of waist circumference, BP, TG, plasma glucose (GLU), and low HDL. All these parameters were estimated using a standard protocol as previously described [14].

Total PA was assessed with Actigraph accelerometers (AG; Model 7164, version 2.2; ActiGraph Health Services, Fort Walton Beach, Florida, USA), which were programmed to record PA over one-minute intervals (60 s epoch). The accelerometers were worn on the hip for six consecutive days, four week days and two weekend days, from the time the participant woke up until he or she went to sleep. Only data from monitors worn a minimum of 8 hours per day, for at least two weekdays and one weekend day were included in the analysis. Average counts per minute (cpm) for these days measured by the accelerometer were calculated for each participant and were used to estimate PA level. Details about PA measured with ActiGraph accelerometers have been described previously [13].

Data from the dietary records were entered into ICEFOOD (program of the Icelandic Nutrition Council) for nutrient calculations, using the Icelandic nutrient database ISGEM which consists of 452 food codes. Nutrient losses due to food preparation were included in the calculations.

2.6. Statistical analysis

Comparisons of variables between groups at baseline were done using the *t*-test for continuous variables and the Chi^2 test for binary variables. Age- and sex-adjusted comparisons at baseline

Table 1
Unadjusted baseline characteristics of subjects randomized to Group 1 (immediate intervention) and Group 2 (delayed intervention).

	Group 1 (n = 56)	Group 2 (n = 61)	Between-group difference[1]	Between-group difference[†]
	Males; n = 25, females; n = 31	Males; n = 29, females; n = 32		
Characteristic	Mean ± SD (range)	Mean ± SD (range)	P-value	P-value
Age	80.8 ± 4.7 (73–90)	78.3 ± 4.1 (71–88)	.003	
Height (cm)	165.5 ± 8.18 (149.0–185.0)	168.5 ± 8.0 (149.0–185.0)	.082	.204
Weight (kg)	75.9 ± 17.2 (49.4–157.0)	78.0 ± 12.3 (50.7–105.8)	.442	.796
BMI (kg/m²)	27.6 ± 5.3 (20.6–45.9)	27.4 ± 3.4 (20.1–36.3)	.793	.406
Fat mass total (kg)	27.9 ± 11.6 (12.4–74.7)	28.3 ± 7.9 (6.5–49.1)	.865	.607
Fat mass of the trunk (kg)	15.4 ± 7.6 (4.5–49.8)	15.3 ± 4.8 (3.0–27.0)	.933	.365
Lean mass total (kg)	45.2 ± 8.0 (31.5–74.0)	47.1 ± 8.5 (32.8–62.9)	.269	.802
Waist circumference (cm)	91.3 ± 14.5 (68–153)	91.7 ± 12.1 (70–120)	.892	.420
SBP (mmHg)	158.9 ± 21.1 (110–218)	154.5 ± 25.5 (105–216)	.231	.254
DBP (mmHg)	78.6 ± 10.2 (57–112)	79.0 ± 10.3 (57–108)	.820	.783
HDL cholesterol (mmol/L)	1.60 ± 0.42 (0.82–2.62)	1.58 ± 0.47 (0.60–2.79)	.856	.675
TG (mmol/L)	1.09 ± 0.51 (0.49–2.86)	1.11 ± 0.59 (0.47–4.26)	.856	.803
Fasting glucose (mmol/L)	5.33 ± 0.67 (4.26–7.75)	5.39 ± 0.70 (4.26–7.75)	.620	.429
Energy intake (kJ/day)	7293 ± 1736 (3742–11,578)	7248 ± 1706 (3739–13,224)	.676	.426
Physical activity (cpm)	259 ± 123 (100–589)	254 ± 102 (106–537)	.694	.275
Hypertension medication (%)	62.5% (n = 35)	54.1% (n = 33)	.358	.554
Current smoker (%)	1.8% (n = 1)	3.3% (n = 2)	.615	.666

Values are shown as numbers in groups (n), means with standard deviation (SD), range and difference between groups with P-value. Values for hypertension medication and current smokers are shown as percentage (%) and number (n). SD: standard deviation; SBP: systolic blood pressure; DBP: diastolic blood pressure; HDL cholesterol: high-density lipoprotein; TG: triglycerides; BMI: body mass index.
[1] Without adjustment.
[†] With adjustment for age and sex.

were made with ordinary least squares regression for continuous variables and logistic regression for binary variables. The difference in each variable at baseline and progression over time was analyzed using a repeated measures model with a first-order autoregressive covariance structure. A parameter was included in the model to represent each time-point for the immediate exercise training group (I), Group 1: μ_{I1}, μ_{I2}, μ_{I3}; and the delayed exercise training group (D), Group 2: μ_{D1}, μ_{D2}, μ_{D3}. An adjustment was made for age and sex. Adjusted means and contrasts between time-points were estimated from linear combinations of the model parameters and are shown in Tables 2 and 3.

Power calculation was conducted on the research. It was given that the mean effect-size was 0.25 SD from each point of every outcome variable with 80% power, where t-test (paired-means test) was used to measure the first against the second measurement. The sample size was estimated 100 ($n = 100$) at the end of the research. The participation was assumed to be 75% and the dropout about 20% because of the duration of the exercise-training intervention. The results were generated using the SAS MIXED model procedure in SAS/STAT software, version 9.2.

3. Results

3.1. Baseline and time-points

The results from the baseline measurements are shown in Table 1. Group 1 was two and a half years older on average. No statistically significant differences were observed between the groups for any of the cardiometabolic risk factors (Table 1). Table 2 shows cardiometabolic risk factors, body composition, energy intake, and PA at the three time-points after adjustments for age

Table 2
Values in means at three time-points in body composition, cardiometabolic risk factors, energy intake and physical activity for subjects in Group 1 and Group 2.

Outcome and values	Group 1			Group 2		
	(n = 56)	(n = 48)	(n = 45)	(n = 61)	(n = 58)	(n = 50)
	Time-point 1	Time-point 2	Time-point 3	Time-point 1	Time-point 2	Time-point 3
	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)
Weight (kg)	77.2 (1.9)	75.9 (1.9)	75.7 (1.9)	76.5 (1.8)	76.0 (1.8)	74.5 (1.8)
BMI (kg/m²)	27.7 (0.6)	27.3 (0.6)	27.3 (0.6)	27.0 (0.6)	26.9 (0.6)	26.4 (0.6)
Fat mass total (kg)	28.2 (1.3)	26.7 (1.3)	27.2 (1.3)	27.2 (1.3)	26.4 (1.3)	25.6 (1.3)
Fat mass of the trunk (kg)	15.7 (0.8)	14.7 (0.8)	14.9 (0.8)	14.6 (0.8)	14.0 (0.8)	13.6 (0.8)
Lean mass total (kg)	46.3 (0.7)	46.7 (0.7)	46.2 (0.7)	46.5 (0.7)	46.8 (0.7)	46.6 (0.7)
Waist circumference (cm)	92.6 (1.5)	86.1 (1.5)	87.2 (1.5)	90.8 (1.5)	86.6 (1.5)	83.7 (1.5)
SBP (mmHg)	158.7 (2.7)	153.3 (2.8)	147.1 (2.9)	154.3 (2.6)	147.9 (2.7)	139.3 (2.8)
DBP (mmHg)	78.8 (1.2)	76.3 (1.3)	73.9 (1.3)	78.4 (1.2)	77.9 (1.2)	73.2 (1.3)
HDL cholesterol (mmol/L)	1.57 (0.1)	1.62 (0.1)	1.68 (0.1)	1.60 (0.1)	1.69 (0.1)	1.70 (0.1)
TG (mmol/L)	1.08 (0.1)	1.02 (0.1)	1.06 (0.1)	1.11 (0.1)	1.17 (0.1)	1.03 (0.1)
Fasting glucose (mmol/L)	5.32 (0.1)	5.42 (0.1)	5.42 (0.1)	5.42 (0.1)	5.60 (0.1)	5.62 (0.1)
Energy intake (kJ/day)	7390 (212)	8105 (226)	7565 (240)	7144 (219)	6988 (220)	7379 (236)
Physical activity (cpm)	272.9 (16.9)	307.1 (15.7)	277.1 (16.4)	247.0 (16.1)	211.7 (15.0)	337.6 (16.0)

Values are shown as means with standard error (SE) at three time-points: baseline (time-point 1), after training-phase by Group 1 and control-phase by Group 2 (time-point 2), and after follow-up by Group 2 and delayed training-phase by Group 2 (time-point 3). The results are presented with an adjustment for age and sex. SE: standard error; SBP: systolic blood pressure; DBP: diastolic blood pressure; HDL cholesterol: high-density lipoprotein; TG: triglycerides; BMI: body mass index.

434 J. Gudlaugsson et al. / European Geriatric Medicine 4 (2013) 431–437

Table 3
Mean changes between time-points 1 and 2 and between time-points 2 to 3 in body composition, cardiometabolic risk factors, energy intake and physical activity for subjects in Group 1 and Group 2.

Outcome and values	Group 1 (n = 48)	Group 1 (n = 45)	Group 2 (n = 58)	Group 2 (n = 50)
	Change from time-point 1 to 2	Change from time-point 2 to 3	Change from time-point 1 to 2	Change from time-point 2 to 3
	Difference in means (95% CI)	Difference in means (95% CI)	Difference in means (95% CI)	Difference in means (95% CI)
Weight (kg)	−1.32 (−1.88 to −0.77)***	−0.20 (−0.77 to 0.38)	−0.55 (−1.05 to 0.04)*	−1.51 (−2.06 to −0.97)***
BMI (kg/m²)	−0.46 (−0.68 to −0.25)***	0.00 (−0.22 to 0.22)	−0.17 (−0.36 to 0.02)	−0.46 (−0.67 to −0.25)***
Fat mass total (kg)	−1.48 (−1.94 to −1.03)***	0.49 (0.00 to 0.95)*	−0.88 (−1.29 to −0.48)***	−0.73 (−1.16 to −0.30)***
Fat mass of the trunk (kg)	−1.02 (−1.35 to −0.69)***	0.22 (−0.12 to 0.55)	−0.62 (−0.92 to −0.32)***	−0.41 (−0.73 to −0.09)*
Lean mass total (kg)	0.40 (0.04 to 0.77)*	−0.43 (−0.80 to −0.06)*	0.27 (−0.06 to 0.60)	−0.13 (−0.48 to 0.22)
Waist circumference (cm)	−6.45 (−7.45 to −5.45)***	1.08 (0.05 to 2.11)*	−4.25 (−5.16 to −3.35)***	−2.92 (−3.89 to −1.95)***
SBP (mmHg)	−5.33 (−9.71 to −0.94)*	−6.24 (−10.77 to −1.70)**	−6.41 (−10.46 to −2.36)**	−8.61 (−12.90 to −4.33)***
DBP (mmHg)	−2.58 (−4.82 to −0.33)*	−2.38 (−4.70 to −0.06)*	−0.46 (−2.52 to 1.60)	−4.74 (−6.93 to −2.55)***
HDL cholesterol (mmol/L)	0.05 (−0.01 to 0.11)	0.07 (0.00 to 0.13)*	0.08 (0.03 to 0.14)**	0.01 (−0.05 to 0.07)
TG (mmol/L)	−0.07 (−0.16 to 0.03)	0.04 (−0. 50 to 0.14)	0.06 (0.02 to 0.14)	−0.14 (−0.22 to 0.05)**
Fasting glucose (mmol/L)	0.10 (0.01 to 0.22)	0.00 (−0.11 to 0.12)	0.18 (0.08 to 0.29)***	0.01 (−0.10 to 0.12)
Energy intake (kJ/day)	714 (260 to 1168)**	−539 (−1020 to −58)*	−156 (−594 to 282)	391 (−68 to 850)
Physical activity (cpm)	34.2 (0.8 to 67.6)*	−30.1 (−60.7 to 0.6)	−35.2 (−66.2 to −4.3)*	125.9 (96.0 to 155.8)***

Values are shown as mean changes (95% CI) between time-point 1 and time-point 2, and between time-point 2 and time-point 3 in Group 1 and Group 2. The results are presented with an adjustment for age and sex.
Significant differences in change between time-points; * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.
MTI: multimodal training intervention; SBP: systolic blood pressure; DBP: diastolic blood pressure; HDL cholesterol: high-density lipoprotein; TG: triglycerides; BMI: body mass index.

and sex, and Table 3 shows changes between time-points 1 and 2 and between time-points 2 to 3.

3.2. Cardiometabolic risk factors

Mean changes between time-points 1 and time-point 2 can be seen in Table 3. After the immediate exercise training-phase, Group 1 decreased their waist circumference (−6.45 cm; $P < 0.001$), systolic blood pressure (SBP) (−5.33 mmHg; $P = 0.017$) and diastolic blood pressure (DBP) (−2.58 mmHg; $P = 0.025$). Group 2, after their control-phase decreased their waist circumference (−4.25 cm; $P < 0.001$), SBP (−6.41 mmHg; $P = 0.002$), but increased HDL (0.08 mmol/L; $P = 0.003$) and GLU (0.18 mmHg; $P < 0.001$) (Table 3).

At time-point 3, Group 1 had increased waist circumference (1.08 cm; $P = 0.040$); SBP and DBP had decreased further (−6.24 mmHg; $P = 0.007$; −2.38 mmHg; $P = 0.045$ respectively), and HDL had risen (0.07 mmol/L; $P = 0.037$). Group 2, in the delayed exercise training-phase, saw decreased waist circumference (−2.92 cm; $P < 0.001$), SBP (−8.61 mmHg; $P < 0.001$), and both lower DBP (−4.74 mmHg; $P < 0.001$) and TG (−0.14 mmol/L; $P = 0.003$) (Table 3).

3.3. Body composition

Group 1 experienced decreased weight (−1.32 kg; $P < 0.001$), BMI (−0.46 kg/m²; $P < 0.001$), total fat mass (−1.48 kg; $P < 0.001$), fat mass of the trunk (−1.02 kg; $P < 0.001$) and increased total lean mass (0.40 kg; $P = 0.031$). In Group 2's control-phase, weight decreased (−0.55 kg; $P = 0.034$), as well as total fat mass (−0.88 kg; $P < 0.001$), and fat mass of the trunk (−0.62 kg; $P < 0.001$) (Table 3).

Between time-points 2 and 3, Group 1 saw increased total fat mass (0.49 kg; $P = 0.035$) and decreased total lean mass (−0.43 kg; $P = 0.024$). Group 2, between the same time-points, while in the delayed exercise training-phase saw decreased weight (−1.5 kg; $P < 0.001$), BMI (−0.46 kg/m²; $P < 0.001$), and both less total fat mass (−0.73 kg; $P = 0.001$) and fat mass of the trunk (−0.41 kg; $P = 0.011$) (Table 3).

3.4. Physical activity and energy intake

For Group 1 in the exercise training-phase, both PA and energy intake increased (34.2 cpm; $P = 0.045$; 714.5 kJ/day; $P = 0.002$). In contrast, Group 2, in control phase saw decreased PA (−35.2 cpm; $P = 0.026$) while energy intake remained unchanged (−155.6 kJ/day; $P = 0.484$) (Table 3).

In Group 1 PA decreased (−30.1 cpm; $P = 0.054$) and energy intake fell (−539.2 kJ/day; $P = 0.028$) in the six-month follow-up phase, but Group 2, in the delayed exercise training-phase, increased PA (125.9 cpm; $P < 0.001$) and had a trend towards increased energy intake (390.9 kJ/day; $P = 0.094$) (Table 3).

3.5. Profiles of change for body composition

The profiles of change for the groups for body composition factors from time-point 1 to time-point 2 were not parallel for weight ($P = 0.043$), but parallel for total fat mass ($P = 0.053$) and total lean mass ($P = 0.529$). From time-point 2 to time-point 3 the profiles of change were not parallel for weight ($P = 0.001$) and total fat mass ($P < 0.001$), but parallel for total lean mass ($P = 0.247$) (Fig. 1A–C).

4. Discussion

This study demonstrates that beneficial health effects can be obtained with regular exercise training and nutritional counseling intervention among elderly people. The main finding was a reduction in waist circumference, BMI and fat mass in both groups. The reduction was more apparent among those involved in active exercise training and nutritional counseling, which increased

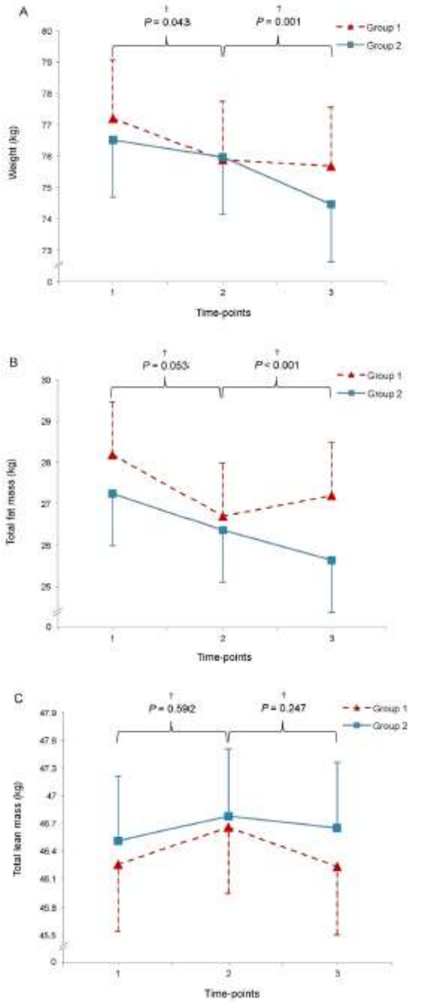

Fig. 1. A–C Outcome measures from test of parallel profiles (†) between Group 1 and Group 2 in weight (A), total fat mass (B) and total lean mass (C) at three time-points: at baseline (1); after 6-month intervention by Group 1 and control phase by Group 2 (2), and after crossover phase by Group 1 and delayed intervention phase by Group 2 (3).

energy intake by 10%, whereas a 2% reduction was observed in the control group. An increase was seen in fat-free mass in Group 1 after the 6-month exercise training but went back to baseline after the 6-month follow-up. No change was seen in metabolic factors, except for TG. SBP was high in both groups but improved steadily constantly over the period of the study.

Weight reduction has been the main goal of most intervention studies of individuals with cardiometabolic risk factors [19], because it most likely activates one or more underlying mechanisms that lead to improvement and positive changes in these risk factors [19–21]. Increased weight and obesity are directly linked to high blood pressure, increased cholesterol and TG, lower HDL and their consequences such as heart disease and stroke. Waist circumference also provides a unique indicator of body fat distribution, which can identify individuals who are at increased risk for obesity related cardiometabolic risk factors, above and beyond the measurement of BMI [22]. In addition, waist circumference monitors the response to diet alone or diet and exercise together [22].

There is a possibility that the loss of weight after the age of 65 is truly attributable to the aging process [23], but the most noticeable and clinically relevant changes occurring with aging is the loss of muscle mass, with the accompanied increase in the proportion of body fat. These changes can have negative consequences for maintaining resting metabolic rate and metabolic resiliency as well as for maintaining reaction time, strength, flexibility, and balance for maintaining an active and independent lifestyle in older age. Therefore, our main focus in the design of the exercise training intervention was to challenge these aging changes without the attention to weight loss in general. An interesting result can be seen in a previously published paper [13] regarding physical performance, strength and endurance, but another important functional change accompanying older age is the loss of cardiovascular plasticity resulting in a decline in maximal heart rate, stroke volume, cardiac output, and arteriovenous oxygen difference [24]. But in our results, we can also see positive changes in the BP as in the fat-free mass by Group 1 or maintaining the fat-free mass by Group 2 after a 6-month exercise training intervention. In the follow-up time by Group 1, we can see the negative decline in the fat-free mass and increase in the fat mass. These changes serve as a reminder of how important it is for this age group to have easy access to fitness programs and professional assistance through the aging period.

As most intervention studies [20], we found reduced weight, BMI, and waist circumference in Group 1 after a 6-month exercise training intervention. In addition, total fat mass decreased by 5.3% and fat mass of the trunk by 6.4% in Group 1 after the intervention, confirming that regular exercise training and nutritional counseling education can reduce weight and visceral fat accumulation [1] and may therefore influence cardiometabolic risk factors [3,4]. Furthermore, Group 1 had a 0.86% increase in total lean mass at time-point 2. That finding demonstrates that older adults have the capacity to increase muscle strength [13] and muscle mass. Such an increase could further enable them to participate in exercise training, which can lead to improvements in the metabolic profile [25,26] as well as improvements in physical, functional, and endurance performance [13].

In both groups, DBP baseline values were normal (as defined in guidelines [7]), while SBP values were elevated. Regular physical activity is said to be a cornerstone of prevention and management of hypertension [27] supported by this study by the decreased BP after the 6-month intervention (time-point 2) in Group 1. Furthermore, Appel et al. [28] showed that a diet rich in fruits, vegetables, low-fat dairy foods and food with reduced saturated and total fat can substantially lower blood pressure. The main goal in our diet recommendations through the intervention was a combination diet rich in fruits, vegetables, and low-fat dairy foods with reduced amounts of saturated fat and total fat.

Interestingly, SBP also decreased in Group 2 (control group) during the first 6 months. The most likely explanation for this decrease in Group 2 is the reduction in body mass and body fat observed in this group as well. The relation between SBP and increased weight and adiposity is well documented [29]. The decreased body mass and body fat in Group 2 could be a result of aging process in such elderly population as well as due to the reduced energy intake during these 6 months. Despite being non-significant, a decline in energy intake of 156 kJ/day (n.s.) may add up to 28,392 kJ over 26 weeks, which corresponds to the fat mass loss observed in this group [30]. In addition, it is possible that the 3-day dietary record taken during baseline measures was sufficient to motivate Group 2 and influence their dietary habits from time-point 1 to time-point 2 as it is known that habitual eating patterns may be influenced or changed by the recording process [31].

From time-point 2 to time-point 3, during which Group 2 received intervention, all the same beneficial effects of the intervention observed in Group 1 at time-point 2 were witnessed in Group 2. At the same time, Group 1 remained unchanged or regressed to baseline values on all variables except BP, which continued to decrease. However, during this period (time-point 2 to time-point 3), Group 1 maintained their strength and aerobic fitness [13], which are recognized to influence BP in a favorable manner [3]. It is also possible that the treatment effects of the hypertensive medications were enhanced by increased exercise training and/or better diet during the intervention and even beyond the intervention period.

The baseline values for the HDL, TG and GLU in our study were normal according to guidelines [7]. Therefore, they were not expected to change much over the course of the study. Although small statistical changes were observed, they are probably not clinically meaningful. More favorable changes in response to exercise training or diet usually occur in people with higher TG's or other blood lipids at baseline [32,33].

It seems that the Icelandic older males are more willing to participate in research like this than males from other countries. An explanation for this increased participation by the males can be attributed to the selection into the study. The spouse was also invited to participate in the study and 25 spouses wished to join the study. This method was used to increase the participation and minimize the dropout. This can also explain the small age difference between the groups after the randomization at baseline. Also, we experienced about 24% dropout during the study, not an unusual dropout rate given age and type of study; another Icelandic resistance exercise study [34] had a 9% dropout rate in a 12-week program compared to 26 weeks in our study.

In a recent paper [35] on the same topic of nutrition counseling and physical exercise, no effect was seen on energy intake or fat-free mass in community-dwelling frail elderly people. In our results we see changes in both lean mass and energy intake for Group 1 after their immediate 6-month exercise training. The reason for the difference may lie in the different health status of the participant, but also in a longer exercise training periods in our design, and higher and/or more accurate frequency, duration and intensity of our training. This is important for achieving one or more type of health outcome from an exercise training intervention for this age group [20].

This study had several limitations. First of all, it is not possible to estimate if the changes resulted from the endurance and resistance exercise training, dietary habits, or both of these elements over the intervention period. Secondly, age-related changes over time could have influenced the biological processes during the control period more rapidly than is normally observed among younger cohorts. Finally, because the study subjects were healthy old people, it may not be possible to generalize and to apply the present findings to older men and women with health problems.

5. Conclusion

Our findings suggest that improvements in body composition in old people may be improved by systematic exercise training in combination with nutrition counseling. Increased muscle strength and change in total lean mass affect metabolic profile in old adults. Regular exercise training in combination with nutrition counseling should be considered to be an integral part of the health care system.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

Acknowledgement

This research project was supported by The Icelandic Centre for Research, The University of Iceland Research Fund, The Ministry of Education, Science and Culture Sport Fund, The Association of Municipalities in the Capital Area, The Fitness Centre Laugar, The Public Health Institute of Iceland and The Icelandic Heart Association.

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Paper III

Paper III

Áhrif 6 mánaða fjölþættrar þjálfunar á hreyfigetu, vöðvakraft, þol og líkamsþyngdarstuðul eldri einstaklinga

– Eru áhrif þjálfunar sambærileg hjá konum og körlum?

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ÁGRIP

Inngangur: Góð hreyfigeta hefur umtalsverð áhrif á sjálfstæði og vellíðan eldra fólks. Slök hreyfigeta getur aftur á móti skert athafnir daglegs lífs. Markmið þessarar rannsóknar var að skoða áhrif 6 mánaða þjálfunar og íhlutunar á hreyfigetu karla og kvenna, hvort þjálfunin hefði ólík áhrif á kynin og hver árangur þjálfunarinnar væri 6 og 12 mánuðum eftir að henni lauk.

Efniviður og aðferðir: Rannsóknin var gerð á 117 einstaklingum á aldrinum 71–90 ára sem höfðu tekið þátt í Öldrunarrannsókn Hjartaverndar. Snið rannsóknarinnar var víxlað með handahófskenndu vali í tvo hópa. Rannsóknin var gerð á þremur 6 mánaða tímabilum að loknum grunnmælingum. Sex mánaða þjálfun var þreytt af þjálfunarhópi (hópi 1) á fyrsta tímabili meðan seinni þjálfunarhópur (hópur 2) var til viðmiðunar. Hópur 2 tók síðan þátt í sams konar þjálfun á öðru tímabili en formleg þjálfun rannsóknaraðila var ekki lengur til staðar fyrir hóp 1. Sex mánuðum eftir að þjálfun hjá hópi 2 var lokið voru mælingar endurteknar í fjórða skiptið.

Niðurstöður: Eftir 6 mánaða íhlutun varð 32% bæting á daglegri hreyfingu karla ($p<0,001$) og 39% hjá konum ($p<0,001$). Á hreyfigetu karla varð um 5% bæting ($p<0,01$) og 7% hjá konum ($p<0,001$). Fótkraftur karla jókst um 8% ($p<0,001$) og kvenna um 13% ($p<0,001$). Bæði karlar og konur bættu hreyfijafnvægi um 10% ($p<0,001$), gönguvegalengd jókst hjá báðum kynjum um 5–6% ($p<0,001$) og líkamsþyngdarstuðull kynjanna lækkaði um tæplega 2% ($p<0,001$). Enginn kynjamunur var af áhrifum þjálfunar. Heildaráhrif þjálfunar á hreyfigetu og hreyfijafnvægi héldust í allt að 12 mánuði eftir að íhlutun lauk.

Ályktun: Fjölþætt þjálfun hefur jákvæð áhrif á hreyfigetu eldri einstaklinga, kynin bregðast á sambærilegan hátt við þjálfun og varðveita áunnar breytingar í hreyfigetu í allt að 12 mánuði. Rannsóknin bendir eindregið til þess að hófleg kerfisbundin þjálfun fyrir þennan aldurshóp ætti að vera hluti af hefðbundinni heilsugæslu aldraðra.

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Greinin barst 18. mars 2013, samþykkt til birtingar 11. júní 2013.

Engin hagsmunatengsl gefin upp.

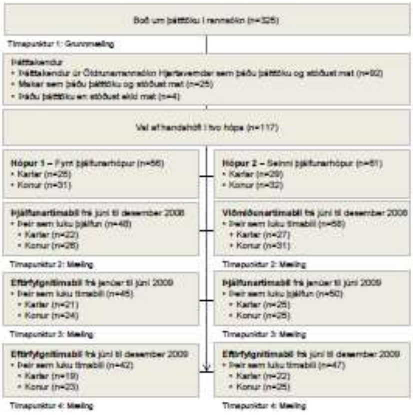
Inngangur

Með hækkandi aldri hefur skert hreyfigeta áhrif á slysatíðni, endurheimt bata eftir veikindi eða slys og dánartíðni.[1] Í rannsókn Leveille og félaga[1] kemur einnig fram verulegur munur á daglegri hreyfingu eldri karla og kvenna þar sem konur hreyfa sig minna. Þrátt fyrir að konur nái hærri lífaldri en karlar er hreyfigeta eldri kvenna minni en karla og þær búa oftar við meiri fötlun.[1,2] Lakari hreyfigeta eldri kvenna í samanburði við karla er viðfangsefni sem rannsaka þarf betur.[2]

Að viðhalda hreyfigetu skiptir sköpum fyrir eldri einstaklinga. Til að viðhalda hreyfigetu og góðri heilsu er mikilvægt, jafnt fyrir hina eldri sem hina yngri, að stunda skipulagða þjálfun þar sem tíðni, ákefð og tímalengd æfinga eru lykilþættir.[3,4] Einnig má snúa skertri hreyfigetu á ákveðnu stigi til betri vegar með markvissri þjálfun.[1,2,5] Sýnt hefur verið fram á að þáttaka í skipulagðri þol- og kraftþjálfun, þar sem æskileg ákefð þjálfunar, þjálfunarmagn og tíðni æfinga eru höfð að leiðarljósi, getur haft jákvæð áhrif á öldrunarferlið og aukið lífsgæði.[3,6] Á síðustu áratugum hefur komið í ljós að lýðgrunduð inngrip (*population-based strategies*), þar sem inngrip eru almenn, eru mun áhrifaríkari í lýðheilsulegu tilliti en aðferðir sem byggja á áhættuskimun og sértækri íhlutun.[7] Flokka má þessa íhlutunarrannsókn undir víðtækt lýðgrundað inngrip.

Vöðvaafl er skilgreint sem hæfileiki vöðva til að mynda afl snögglega en vöðvakraftur er skilgreindur sem magn af krafti sem vöðvi eða vöðvahópur getur framleitt með einum hámarkssamdrætti.[8] Minnkandi vöðvaafl og vöðvakraftur í neðri útlimum líkamans er oft skýringin á takmarkaðri hreyfigetu fólks í eldri aldurshópum.[4] Aftur á móti hefur aukinn vöðvakraftur í kjölfar kraftþjálfunar verið tengdur við aukna hreyfigetu, betra jafnvægi og minni fallhættu.[4,9] Jafnvægi má skilgreina sem ferli þar sem einstaklingur hefur stjórn á líkama sínum í uppréttri stöðu eða á hreyfingu. Greina má jafnvægi í stöðujafnvægi (*static balance*) og hreyfijafnvægi (*dynamic balance*) þar sem einstaklingur viðheldur jafnvægi meðan hann færir sig úr stað.[5]

Markmið þessarar rannsóknar var að greina áhrif 6 mánaða fjölþættrar þjálfunar (6-MFÞ) á karla og konur á aldrinum 71 til 90 ára og kanna hvort þjálfunaráhrif á heilsufarsbreytur yrðu mismunandi milli kynja. Auk þess var markmiðið að rannsaka hvort íhlutunaráhrifin vöruðu jafn lengi hjá báðum kynjum eftir að þjálfunartíma lauk. Grein úr sömu rannsókn hefur birst í tímaritinu *International Journal of Behavioral Nutrition and Physical Activity*[10] þar sem fjallað var um áhrif þjálfunarinnar án þess að gerð væri grein fyrir áhrifunum á kynjamun sem er meginmarkmið þessarar greinar.



Mynd 1. *Flæðirit rannsóknar.*

Efniviður og aðferðir

Snið rannsóknar og þátttakendur

Snið rannsóknar var víxlað þar sem þátttakendum (n=117) var skipt af handahófi í tvo hópa, þjálfunarhóp 1 (H-1; n=56) og þjálfunarhóp 2 (H-2; n=61) (mynd 1). Að loknum grunnmælingum fór þjálfunar- og rannsóknartími fram í þremur 6 mánaða tímabilum.[30] H-1 hóf þjálfun sem stóð yfir í 6 mánuði meðan H-2 virkaði sem viðmiðunarhópur á sama tíma. Eftir 6-MFÞ hjá H-1 voru mælingar endurteknar hjá báðum rannsóknarhópum (tímapunktur 2). Afskiptum rannsakenda af þjálfun H-1 lauk á þessum tímapunkti. Næstu 6 mánuði tók H-2 þátt í samskonar þjálfun og H-1. Eftir þjálfunartíma H-2 voru mælingar endurteknar hjá báðum hópum (tímapunktur 3) og lauk þá afskiptum rannsóknaraðila af þjálfun H-2. Sex mánuðum eftir að H-2 lauk sinni þjálfun voru mælingar endurteknar í fjórða sinn á báðum hópum (tímapunktur 4) (mynd 1).

Þátttakendur í þessari rannsókn voru heilbrigðir einstaklingar sem höfðu áður tekið þátt í Öldrunarrannsókn Hjartaverndar (*AGES Reykjavik Study*).[11] Þeim sem höfðu náð ≥23 stigum úr MMSE-prófi (*Mini Mental State Examination*), ≥17 stigum úr DSST-prófi (*Digit Symbol Substitution Test*) og ≥7 stigum úr SPPB-hreyfifærniprófi (*The Short Physical Performance Battery Test*)[12] var boðið að taka þátt í þessari íhlutunarrannsókn.

Af þeim 325 eldri einstaklingum sem höfðu náð 70 ára aldri þáðu 96 að taka þátt í rannsókninni. Af þeim uppfylltu 92 kröfur um þátttöku. Þá var mökum einnig boðin þátttaka og þáðu það 25 einstaklingar. Helstu ástæður fyrir að hafna þátttöku voru of langur og bindandi rannsóknartími, áhugaleysi og veikindi maka. Þátttakendur fylltu út spurningalista um almenna heilsutengda þætti sem trúnaðarlæknir fór yfir í öryggisskyni og samþykkti þátttöku með tilliti til þeirrar þjálfunar sem framundan var. Allir þátttakendur rituðu undir upplýst samþykki. Rannsóknin var tilkynnt til Persónuverndar og samþykkt af Vísindasiðanefnd (VSNb2008030014/03-1).

Þjálfun og íhlutanir

Íhlutun fólst í 6 mánaða fjölþættri þjálfun með áherslu á daglega þolþjálfun og kraftþjálfun tvisvar sinnum í viku. Þessu til stuðnings voru fjórir fyrirlestrar um eftirfarandi þætti; heilsutengda öldrun, þolþjálfun, kraftþjálfun og skipulag þjálfunar, auk þriggja fyrirlestra um næringu.

Þolþjálfun var fólgin í daglegri göngu á 6 mánaða þjálfunartíma. Tímalengd hverrar æfingar jókst stig af stigi, frá 20 mínútna æfingum fyrstu vikuna í rúmlega 40 mínútur síðustu vikurnar. Meðalþjálfunartími á tímabilinu var áætlaður um 35 mínútur á dag en það er sá tími sem sérfræðingar á sviði öldrunar áætla að þurfi til að viðhalda starfsemi hjartans, æða- og lungnakerfisins.[13] Kraftþjálfun fór fram í líkams- og heilsuræktarstöð tvisvar sinnum í viku, á þriðjudögum og föstudögum. Kraftþjálfun var einstaklingsmiðuð og innihélt 12 æfingar fyrir helstu vöðvahópa líkamans. Sérhæfð kraftþjálfunartæki voru notuð og var þjálfunin ávallt undir leiðsögn íþróttafræðinga. Markmið fyrri hluta þjálfunartímans voru fólgin í kennslu, aðlögun og þjálfun á vöðvaþoli, en vöðvaþol er hæfileiki vöðvanna til að endurtaka oft samdrátt án þess að þreyta myndist.[8] Þjálfun á vöðvaafli var meginmarkmiðið á seinni þremur mánuðum þjálfunartímans.[30]

Á íhlutunartíma voru skipulagðir þrír stuttir fyrirlestrar um næringu fyrir báða hópa. Einstaklingar í H-2 fengu einnig einstaklingsviðtöl og ráðgjöf um næringu á seinna þjálfunartímabili og tvær kennslustundir í eldhúsi. Fyrirlestrar voru byggðir á ráðleggingum um mataræði fyrir eldri aldurshópa frá Lýðheilsustöð og Landlæknisembætti.[34] Frekari upplýsingar um íhlutun rannsóknarinnar er að finna í fyrri grein.[30]

Mælingar

Hæð var mæld með 0,1 cm nákvæmni með viðurkenndum hæðarmæli (*Seca 206*) og þyngd með 0,1 kg nákvæmni með viðurkenndum þyngdarmæli sem innihélt stillanlegan kvarða (*Seca HV120*). Líkamsþyngdarstuðull (LÞS) var reiknaður út með því að deila hæð í öðru veldi (m^2) í líkamsþyngd (kg). Til að mæla líkamlega hreyfigetu var SPPB-prófið notað en hreyfijafnvægi var mælt með 8-feta gönguprófi (*8-foot up-and-go test*). Kraftur var mældur í sérhönnuðu kraftmælingatæki (*adjustable dynamometer chair*) og þol mælt með 6 mínútna gönguprófi (6MW). Dagleg hreyfing var mæld með hreyfimælum (*actigraph accelerometers*). Eingöngu var notast við gögn úr mælum sem höfðu mælt hreyfingu í minnst einn helgardag og tvo virka daga, minnst 8 klukkustundir hvern dag. Lýðfræðilegum og klínískum rannsóknarniðurstöðum var safnað af þjálfuðum rannsakendum. Frekari upplýsingar um mælingar rannsóknarinnar er að finna í fyrri grein.[30]

Tölfræðileg úrvinnsla

Aðhvarfsgreining fyrir endurteknar mælingar var notuð við tölfræðigreiningu á gögnunum. Til þess að gera grein fyrir fylgni á milli mælinga á sama einstaklingi var notaður slembiþáttur (*random effect*). Notuð var sjálfsaðhverf samfylgni (*first order autoregressive covariance*) milli mælinga. Stikar fyrir hvort kyn fyrir sig voru hafðir í líkaninu til að endurspegla væntigildi á hverjum tímapunkti fyrir H-1 (I): μ_{I1}, μ_{I2}, μ_{I3}, μ_{I4}, og H-2 (D): μ_{D1}, μ_{D2}, μ_{D3}, μ_{D4} (samtals 16 stikar). Leiðrétt var fyrir aldri. Allir þátttakendur

Tafla I. *Grunnupplýsingar um þátttakendur sem var skipt í fyrri þjálfunarhóp (Hópur 1) og seinni þjálfunarhóp (Hópur 2).*

Mælingar og gildi	Karlar	Konur	Kynjamunur
	Hópur 1 (n=25)	Hópur 1 (n=31)	
	Hópur 2 (n=29)	Hópur 2 (n=32)	
	Meðaltal ± SD (Bil)	Meðaltal ± SD (Bil)	p-gildi
Aldur (ár)			
Hópur 1	81,9 ± 4,8 (75-90)	79,9 ± 4,6 (73-89)	0,09
Hópur 2	79,0 ± 4,3 (71-88)	77,8 ± 3,8 (72-85)	0,05
LÞS (stig)			
Hópur 1	26,9 ± 4,6 (22,5-45,9)	28,2 ± 5,7 (20,6-43,2)	0,49
Hópur 2	27,1 ± 2,9, (20,1-32,2)	27,7 ± 3,8 (22,9-36,3)	0,77
SPPB (stig)			
Hópur 1	10,0 ± 1,6 (7-12)	10,2 ± 1,4 (7-12)	0,88
Hópur 2	9,9 ± 1,5 (7-12)	10,0 ± 1,0 (7-12)	0,98
Jafnvægi (stig)			
Hópur 1	3,2 ± 0,9 (2-4)	3,4 ± 0,8 (2-4)	0,70
Hópur 2	3,2 ± 0,9 (1-4)	3,3 ± 0,9 (1-4)	0,71
Ganga 4 m (s)			
Hópur 1	3,5 ± 0,7 (2,6-5,1)	3,8 ± 1,0 (2,3-8,4)	0,01
Hópur 2	3,5 ± 0,6 (2,6-4,9)	3,6 ± 0,4 (2,7-4,4)	0,61
Stóll (s)			
Hópur 1	12,9 ± 2,8 (7,6-16,9)	12,7 ± 2,4 (7,7-18,0)	0,94
Hópur 2	13,2 ± 2,8 (9,0-19,6)	13,1 ± 2,4 (8,4-19,9)	0,91
8 feta hreyfijafnvægi (s)			
Hópur 1	6,1 ± 1,2 (4,4-9,0)	6,7 ± 1,6 (4,6-13,2)	0,01
Hópur 2	6,5 ± 1,3 (4,4-9,7)	6,5 ± 0,9 (4,6-9,2)	0,70
Fótkraftur (Newton)			
Hópur 1	394,4 ± 81,6 (212,2-547,5)	275,1 ± 71,6 (127,1-386,6)	<0,001
Hópur 2	396,2 ± 75,0 (209,8-585,9)	271,7 ± 62,2 (150,0-405,4)	<0,001
6MW (m)			
Hópur 1	465,4 ± 91,7 (256,0-638,0)	437,6 ± 76,4 (274,0-656,0)	0,03
Hópur 2	466,5 ± 72,7 (300,0-612,0)	463,7 ± 57,3 (333,0-562,0)	0,25
PA (cpm)			
Hópur 1	288,7 ± 144,8 (103,4-588,5)	235,8 ± 98,0 (100,1-445,9)	0,05
Hópur 2	248,1 ± 113,6 (105,8-537,4)	259,3 ± 92,0 (109,4-480,7)	0,67

Gildi eru sýnd í fjölda þátttakenda (n), meðaltölum með staðalfráviki (SD), bili og tölfræðilegum mun milli hópa (p-gildi).
SD = staðalfrávik. LÞS = líkamsþyngdarstuðull. SPPB = hreyfifærniprof [sic] (Short Physical Performance Battery Test).
s = sekúndur. 6MW = 6 mínútna gönguprof [sic]. m = metrar. PA = dagleg hreyfing.
cpm = slög á mínútu.

höfðu að minnsta kosti grunnmælingu skrásetta og mælingu að lokinni íhlutun. Samanburður milli tímapunkta var metinn með línulegum tengslum út frá stikum líkans. Dæmi um slíkt er eftirfarandi: Munur milli hópa á grunnmælingum (tímapunktur 1) var metinn sem $\mu_{I1} - \mu_{D1}$. Áhrif þjálfunar H-1 (tímapunktur 1 til 2) voru metin sem $\mu_{I2} - \mu_{I1}$. Breyting milli endurtekinna mælinga (tímapunktur 1 og 2) var metin hjá H-2 sem $\mu_{D2} - \mu_{D1}$. Áhrif þjálfunar hjá H-2 voru metin sem $\mu_{D3} - \mu_{D2}$. Heildaráhrif íhlutunar hjá báðum hópum voru metin sem $(\mu_{I2} - \mu_{I1} + \mu_{D3} - \mu_{D2})/2$ og heildaráhrif rannsóknar fyrir alla tímapunkta hjá báðum hópum á tímapunkti 4 voru metin sem $(\mu_{I4} - \mu_{I1} + \mu_{D4} - \mu_{D1})/2$. Að því loknu var kannað hvort munur væri milli kynja á þessum línulegum tengslum. Greining á hlutfallslegum mun var gerð þannig að útkomum var logra-varpað. Túlkun stika verður þá prósentumunur í útkomu fyrir breytingu um hverja einingu í skýribreytu eftir að búið er að varpa niðurstöðum til baka. Niðurstöður voru greindar með notkun á *SAS MIXED model procedure* í *SAS/STAT* hugbúnaðinum, útgáfu 9.2.

Niðurstöður

Þátttakendur og brottfall

Samtals 48 þátttakendur (85,7%), 22 karlar og 26 konur úr H-1 luku þjálfunartímabili en 50 þátttakendur (82%), 25 karlar og 25 konur, luku þjálfunartímabili hjá H-2 (tafla I). Helstu ástæður fyrir brottfalli voru veikindi maka og tímaskortur vegna fjölskylduaðstæðna. Marktækur munur (p<0,05) kom í ljós á aldri þeirra 98 þátttakenda sem luku þjálfun (78,9 ± 4,5) og þeirra 19 sem ekki luku þjálfun (82,6 ± 3,5).

Íhlutunar- og viðmiðunartímabil

Tafla II sýnir þjálfunaráhrif íhlutunar hjá H-1 og breytingar á viðmiðunartímabili hjá H-2.

Niðurstöður bæði karla og kvenna í H-1 sýndu um 6% bætingu á heildarstigafjölda SPPB-prófs (p<0,05), rúmlega 8–9% bætingu í 4 mínútna göngu (p<0,01) og tæplega 13% bætingu í stólæfingu (p<0,001). Í 8-feta hreyfijafnvægi mældist 9–10% bæting (p<0,001) og LÞS lækkaði um tæplega 2% hjá bæði körlum og konum (p<0,01). Í 6MW jókst gönguvegalengd hjá körlum um tæplega 10% (p<0,001) og hjá konum um rúmlega 6% (p<0,001). Tæplega 14% bæting varð á fótkrafti kvenna (p<0,001) en rúmlega 5% hjá körlum (p=0,112). Hreyfing H-1 á íhlutunartímabili jókst hjá báðum kynjum um 15–16% en niðurstöður voru ekki tölfræðilega marktækar. Munur á áhrifum þjálfunar á kynin var ekki tölfræðilega marktækur (tafla II).

Niðurstöður frá viðmiðunartímabili H-2 má einnig sjá í töflu II. Karlar í H-2 bættu árangur sinn um 7% í heildarstigafjölda SPPB-prófs (p=0,002) miðað við grunnmælingu en hjá konum var niðurstaðan óbreytt. Þessi breyting á SPPB-prófi milli kynja var marktæk (p=0,01). Í jafnvægisprófi SPPB varð ávinningur hjá körlum um 14% (p=0,03) en konunum hrakaði um 7%, þó versnunin hafi ekki verið tölfræðilega marktæk (p=0,21). Kynjamunur var þó tölfræðilega marktækur, körlum í hag (p=0,02). Krafti í fótvöðvum hrakaði um 7% hjá körlum (p=0,01) auk þess sem bæði karlar og konur hreyfðu sig minna á þessu tímabili, karlar um 18% (p=0,02) og konur um 14% (p=0,05) (tafla II).

Eftirfylgnitímabil H-1 og íhlutunartímabil H-2

Tafla III sýnir niðurstöður á fyrra eftirfylgnitímabili H-1 og á íhlutunartímabili H-2. Konur í H-1 bættu árangur sinn í stólæfingu SPPF-prófs á tímabilinu um 7% (p=0,01) og karlar hreyfðu sig 16% minna (p=0,03) á tímabilinu í samanburði við lok þjálfunartímabils. Annar munur hjá hvoru kyni fyrir sig var ekki til staðar en um 1,8% kynjamunur kom fram á LÞS (p=0,03), þar sem stuðullinn hækkaði hjá körlum en lækkaði hjá konum.

Á þjálfunartímabili H-2 komu fram sambærilegar jákvæðar breytingar við þær sem komu fram að loknu þjálfunartímabili H-1, auk þess sem kynin brugðust á sambærilegan hátt við þjálfuninni. Þessar niðurstöður eru að finna í töflu III.

Tafla II. *Hlutfallsleg breyting frá grunnmælingum á mældum þáttum hjá körlum og konum og próf fyrir kynjamun á íhlutunar- og viðmiðunartímabili.*

	Hópur 1 (Íhlutunartímabil)				Hópur 2 (Viðmiðunartímabil)			
	Íhlutunartímabil		Munur		Viðmiðunartímabil		Munur	
Mælingar og gildi	Karlar Áhrif † (95% ÖB)	Konur Áhrif † (95% ÖB)	Kyn Áhrifamunur † (95% ÖB)	p-gildi fyrir kynjamun	Karlar Áhrif † (95% ÖB	Konur Áhrif † (95% ÖB	Kyn Áhrifamunur † (95% ÖB)	p-gildi fyrir kynjamun
LÞS (kg/m²)	-1, 6 (-2,7, -0,4)**	-1,8 (-2,9, -0,8)***	0,3 (-1,3, 1,9)	0,74	-1,0 (-2,0, 0,1)	-0,4 (-1,3, 0,6)	-0,6 (-2,0, 0,8)	0,40
SPPB (stig)	5,8 (0,8, 11,1)*	5,8 (1,2, 10,6)*	0,0 (-6,4, 6,9)	0,99	7,2 (2,5, 12,1)**	-0,7,0 (-4,7, 3,5)	7,9 (1,6, 14,7)	0,01
Jafnvægi (stig)	3,4 (-9,3, 18,0)	0,3 (-11,1, 13,0)	3,1 (-13,7, 23,2)	0,73	13,9 (1,0, 28,4)*	-7,0 (-16,9, 4,1)	22,4 (3,8, 44,3)	0,02
Ganga 4 m (s)	-9,3 (-14,5, -3,7)**	-8,1 (-13,0, -3,0)**	-1,2 (-8,9, 7,0)	0,76	-4,2 (-9,3, 1,1)	-6,4 (-11,0, 1,6)*	2,3 (-5,0, 10,2)	0,54
Stóll (s)	-12,8 (-17,9, -7,4)***	-12,7 (-17,3, -7,8)***	-0,1 (-7,9, 8,3)	0,97	-5,2 (-10,2, 0,0)	-3,4 (-8,2, 1,6)	-1,9 (-8,9, 5,7)	0,62
8-feta hreyfi-jafnvægi (s)	-10,1 (-15,1, -4,8)***	-9,3 (-13,9, -4,4)***	-0,9 (-8,3, 7,1)	0,82	-0,9 (-6,0, 4,5)	2,7 (-2,2, 7,8)	-3,5 (-10,2, 3,7)	0,33
Fótkraftur (Newton)	5,3 (-1,2, 12,2)	13,8 (7,4, 20,7)***	-7,5 (-15,2, 0,9)	0,08	-7,0 (-12,2, -1,5)*	-3,4 (-8,5, 1,9)	-3,7 (-11,0, 4,3)	0,35
6MW (m)	9,6 (5,5, 13,9)***	6,3 (2,6, 10,1)***	3,1 (-2,1, 8,6)	0,25	1,6 (-1,8, 5,2)	-2,7 (-5,8, 0,4)	4,5 (-0,3, 9,5)	0,07
PA (cpm)	15,7 (-3,4, 38,6)	15,0 (-2,0, 35,0)	0,6 (-20,9, 28,0)	0,96	-17,5 (-20,9, 28,0)*	-14,4 (-26,6, -0,3)*	-3,6 (-22,8, 20,3)	0,75

Gildin eru sýnd sem meðaltöl 95% vikmarka (95% ÖB) hjá körlum og konum, munur á áhrifum íhlutunar í prósentum (%) og tölfræðilegri marktækni (p-gildi); *p<0,05, ** p <0,01, *** p <0,001.
Niðurstaðan er sýnd með leiðréttingu fyrir aldri þar sem gögnum var logra-varpað.
† Hlutfall í prósentum (%) af gögnum sem var logra-varpað. LÞS = líkamsþyngdarstuðull. SPPB = hreyfifærnipróf (Short Physical Performance Battery Test).
s = sekúndur. 6MW = 6 mínútna gönguspróf. m = metrar. PA = dagleg hreyfing. cpm = slög á mínútu

Þjálfunaráhrif beggja hópa og heildaráhrif til lengri tíma
Tafla IV sýnir sameiginleg áhrif þjálfunar þátttakenda úr báðum hópum, karla annars vegar (n=41) og kvenna hins vegar (n=48) sem luku við 6-MFÞ. Niðurstöður sýna tölfræðilega marktækan jákvæðan mun hjá báðum kynjum á öllum útkomubreytum fyrir utan jafnvægi hjá konum.

Tafla V sýnir heildaráhrif íhlutunar á hvort kynið fyrir sig, breytingar frá upphafi (tímapunktur 1) til loka rannsóknar (tímapunktar 4) og hvort munur á áhrifum þjálfunar á kynin sé til staðar við lok rannsóknar. LÞS lækkaði hjá báðum kynjum á tímabilinu, hjá körlum um 1,9% (p=0,007) og hjá konum um 2,6% (p<0,001). Bæði karlar (p<0,001) og konur (p<0,001) sýndu rúmlega 11% framfarir á heildarniðurstöðum á SPPB-prófi og í 4 mínútna göngu sýndu karlar 17% framfarir (p<0,001) og konur 19% (p<0,001). Í stólæfingu SPPB-prófsins voru framfarirnar rúmlega 20% hjá báðum kynjum (p<0,001) og 13–14% bæting varð í 8-feta hreyfijafnvægi (p<0,001) hjá kynjunum. Marktækur munur kom fram á gönguvegalengd karla í 6MW en vegalendin jókst um

Tafla III. *Hlutfallsleg breyting á mældum þáttum hjá körlum og konum og próf fyrir kynjamun á eftirfylgni- og íhlutunartímabili.*

	Hópur 1 (Eftirfylgnitímabil)				Hópur 2 (Íhlutunartímabil)			
	Eftirfylgnitímabil		Munur		Íhlutunartímabil		Munur	
Mælingar og gildi	Karlar Áhrif † (95% ÖB)	Konur Áhrif † (95% ÖB)	Kyn Áhrifamunur † (95% ÖB)	p-gildi fyrir kynjamun	Karlar Áhrif † (95% ÖB	Konur Áhrif † (95% ÖB	Kyn Áhrifamunur † (95% ÖB)	p-gildi fyrir kynjamun
LÞS (kg/m²)	0,9 (-0,3, 2,1)	-0,9 (-2,0, 0,2)	1,8 (0,2, 3,5)	0,03	-1,6 (-2,7, -0,6)**	-1,7 (-2,8, -0,6)**	0,1 (-1,5, 1,6)	0,93
SPPB (stig)	3,0 (-2,0, 8,3)	3,5 (-1,3, 8,4)	-0,4 (-7,0, 6,6)	0,90	3,4 (-1,2, 8,3)	7,9 (3,1, 12,9)**	-4,2 (-10,1, 2,2)	0,20
Jafnvægi (stig)	4,6 (-8,8, 19,8)	1,0 (-11,1, 14,6)	3,6 (-14,0, 24,7)	0,71	-1,6 (-13,1, 11,4)	12,5 (-0,4, 27,0)	-12,5 (26,5, 4,1)	0,13
Ganga 4 m (s)	1,1 (-4,9, 7,4)	-1,1 (-6,5, 4,7)	2,1 (-6,0, 11,0)	0,62	-1,8 (-7,1, 3,5)	-1,9 (-7,1, 3,7)	0,1 (-7,5, 8,2)	0,98
Stóll (s)	-3,0 (-8,8, 3,2)	-7,1 (-12,3, -1,7)*	4,4 (-4,0, 13,6)	0,31	-8,7 (-13,7, -3,5)**	-10,7 (-15,6, -5,5)***	2,2 (-5,6, 10,6)	0,59
8-feta hreyfijafnvægi (s)	-1,1 (-6,7, 4,9)	-0,6 (-5,9, 5,0)	0,5 (-8,1, 7,8)	0,91	-10,0 (-14,7, 5,0)***	-10,0 (-14,7, -5,1)***	0,1 (-7,2, 7,9)	0,99
Fótkraftur (Newton)	-1,6 (-7,7, 4,9)	-5,1 (-10,6, 0,8)	3,7 (-5,0, 13,2)	0,42	11,1 (4,7, 18,0)***	11,6 (5,3, 18,2)***	-0,4 (-8,3, 8,2)	0,93
6MW (m)	-1,8 (-5,6, 2,2)	-2,8 (-6,3, 0,9)	1,0 (-4,3, 6,7)	0,71	1,4 (-2,2, 5,1)	5,7 (2,1, 9,5)**	-4,1 (-8,8, 0,9)	0,10
PA (cpm)	-16,1 (-28,2, -2,0)*	-6,0 (-19,4, 9,6)	-10,8 (-28,3, 11,0)	0,31	51,1 (30,0, 75,7)***	68,1 (44,5, 95,5)***	-10,1 (-27,4, 11,3)	0,33

Gildin eru sýnd sem meðaltöl 95% vikmarka (95% ÖB) hjá körlum og konum, munur á áhrifum íhlutunar í prósentum (%) og tölfræðilegri marktækni (p-gildi); *p<0,05, ** p <0,01, *** p <0,001.
Niðurstaðan er sýnd með leiðréttingu fyrir aldri þar sem gögnum var logra-varpað. † Hlutfall í prósentum (%) af gögnum sem var logra-varpað. LÞS = líkamsþyngdarstuðull.
SPPB = hreyfifærnipróf (Short Physical Performance Battery Test). s = sekúndur. 6MW = 6 mínútna gönguspróf. m = metrar. PA = dagleg hreyfing. cpm = slög á mínútu.

Tafla IV. *Hlutfallsleg breyting á mældum þáttum hjá körlum og konum beggja hópa sem luku þjálfun og próf fyrir kynjamun að loknu íhlutunartímabili.*

	Karlar Áhrif † (95% ÖB	Konur Áhrif † (95% ÖB	Kyn Áhrifamunur † (95% ÖB)	p-gildi fyrir kynjamun
LÞS (kg/m²)	-1,6 (-2,4, -0,8)***	-1,8 (-2,5, -1,0)***	0,2 (-0,9, 1,3)	0,77
SPPB (stig)	4,6 (1,2, 8,2)**	6,8 (3,5, 10,3)***	-2,1 (-7,0, 2,6)	0,37
Jafnvægi (stig)	0,9 (-7,9, 10,4)	6,2 (-2,5, 15,7)	-5,0 (-16,1, 7,6)	0,42
Ganga 4 m (s)	-5,6 (-8,6, -1,7)**	-5,0 (-8,6, -1,3)**	-0,6 (-6,0, 5,2)	0,84
Stóll (s)	-10,8 (-14,4, -7,0)***	-11,7 (-15,1, -8,1)***	1,0 (-4,5, 6,9)	0,72
8 feta hreyfijafnvægi (s)	-10,0 (-13,5, -6,4)***	-9,7 (-13,0, -6,2)***	-0,4 (-5,7, 5,1)	0,88
Fótkraftur (Newton)	8,2 (3,6, 13,0)***	12,7 (8,2, 17,4)***	-4,0 (-9,6, 1,9)	0,18
6MW (m)	5,4 (2,7, 8,2)***	6,0 (3,4, 8,7)***	-0,5 (-4,1, 3,1)	0,77
PA (cpm)	32,2 (17,6, 48,7)***	39,0 (24,5, 55,2)***	-4,9 (-19,0, 11,7)	0,54

Gildin eru sýnd sem meðaltöl 95% vikmarka (95% ÖB) hjá körlum og konum, munur á áhrifum íhlutunar í prósentum (%) og tölfræðilegri marktækni (p-gildi); *p<0,05, ** p <0,01, *** p <0,001. Niðurstaðan er sýnd með leiðréttingum fyrir aldri þar sem gögnum var logra-varpað.
† = Hlutfall í prósentum (%) af gögnum sem var logra-varpað.
LÞS = líkamsþyngdarstuðull. SPPB = hreyfifærnipróf (Short Physical Performance Battery Test). s = sekúndur. 6MW = 6 mínútna göngupróf. m = metrar.
PA = dagleg hreyfing. cpm = slög á mínútu.

4,5% (p=0,04) og kvenna um 3,7% (p=0,07) á þessum tíma. Enginn munur fannst á áhrifum þjálfunar á tímapunkti 4 milli kynjanna.

Umræða

Helstu niðurstöður þessarar rannsóknar voru hin jákvæðu áhrif sem þessi 6 mánaða þjálfun hafði á daglega hreyfingu, hreyfigetu, hreyfijafnvægi, vöðvakraft, þol og LÞS karla og kvenna á aldrinum 71 til 90 ára. Þjálfunaráhrifin voru hliðstæð hjá báðum kynjum auk þess sem ending áunninna breytinga í hreyfigetu til lengri tíma, allt að 12 mánuðum, er athyglisverð.

Skert hreyfigeta, sem meðal annars má meta með 8-feta hreyfijafnvægi og SPPB-prófi, hefur sterka tengingu við veikleika í stoðkerfi neðri hluta líkamans, sér í lagi vöðvakraft, og eykur líkur á því að eldri einstaklingar detti.[15] Slíkur veikleiki leiðir auk þess af sér minni hreyfigetu og fötlun.[5,15] Niðurstöður þessarar rannsóknar eru því áhugaverðar en hún sýnir sambærilegan ávinning hjá körlum og konum á hreyfigetu og hreyfijafnvægi í lok 6-MFÞ. Þá er ávinningur enn til staðar 12 mánuðum eftir að þjálfun rannsóknaraðila lýkur.

SPPB-prófi er skipt í þrjú próf; mat á jafnvægi, að standa fimm sinnum upp úr stól og 4 mínútna göngu þar sem gengið skal á eðlilegum gönguhraða. Prófin þrjú hafa sérstakt matskerfi en saman mynda þau eitt heildarmat. Með skírskotun til sérfræðinga[5,15] sem rannsakað hafa þýðingu á breytingum SPPB-prófs, sýna niðurstöður þessarar rannsóknar umtalsverðar jákvæðar breytingar, bæði í heildarniðurstöðum SPPB, að standa upp úr stól og 4 mínútna göngu. SPPB mælingin, þar sem staðið er upp úr stól, mælir vel vöðvakraft í fótum.[16] Á sama tíma og karlar og konur í H-1 bæta sig á þjálfunartíma, hrakar körlum í H-2 á viðmiðunartímabili. Þeir bæta sig aftur á móti eftir að þeir fá samskonar þjálfun og H-1 auk þess sem dagleg hreyfing þeirra eykst eftir að hafa hrakað á viðmiðunartímabili. Þessar góðu niðurstöður má tengja við þá þjálfun sem stunduð var, ekki síst kraftþjálfunina, en í rannsóknum hefur komið í ljós að vöðvakraftur hefur sterk línuleg tengsl við heildarniðurstöður SPPB-prófs og almenna hreyfigetu.[16-19] Í rannsókn Teixeira-Salmela og félaga[20] á 4 mínútna göngu eftir 7 mánaða þjálfun eldri aldurshópa voru niðurstöður sambærilegar og í okkar rannsókn en aftur á móti tapaðist ávinningur í þeirri rannsókn á einum mánuði eftir að þjálfun lauk. Talið er að 4 mínútna göngupróf SPPB prófsins sé mjög gott mælitæki til að greina breytingu á hreyfigetu eldri aldurshópa auk þess sem prófið hefur mikilvægt forspárgildi um hæfni til að ráða við athafnir daglegs lífs (ADL).[5,20] Í þessari rann-

Tafla V. *Hlutfallsleg breyting á mældum þáttum hjá körlum og konum beggja hópa og próf fyrir kynjamun í lok rannsóknar.*

	Karlar Áhrif † (95% ÖB	Konur Áhrif † (95% ÖB	Kyn Áhrifmunur † (95% ÖB)	p-gildi fyrir kynjamun
LÞS (kg/m²)	-1,9 (-3,3, -0,5)**	-2,6 (-3,9, -1,3)***	0,7 (-1,2, 2,6)	0,46
SPPB (stig)	11,6 (6,6, 16,8)***	11,4 (6,8, 16,3)***	0,2 (-5,9, 6,6)	0,96
Jafnvægi (stig)	9,6 (-1,5, 22,0)	8,3 (-1,9, 19,5)	1,2 (-12,5, 17,1)	0,87
Ganga 4 m (s)	-17,5 (-22,1, -12,6)***	-19,5 (-23,7, -15,0)***	2,4 (-5,3, 10,8)	0,55
Stóll (s)	-20,6 (-25,4, -15,4)***	-21,8 (-26,3, -17,1)***	1,6 (-6,8, 10,8)	0,72
8-feta hreyfijafnvægi (s)	-14,2 (-19,1, -9,0)***	-12,6 (-17,3, -7,7)***	-1,8 (-9,4, 6,5)	0,66
Fótkraftur (Newton)	0,7 (-6,0, 7,9)	2,2 (-4,1, 8,9)	-1,4 (-10,3, 8,2)	0,76
6MW (m)	4,5 (0,1, 9,0)*	3,7 (-0,3, 8,0)	0,7 (-5,0, 6,7)	0,82
PA (cpm)	-0,2 (-15,0, 17,1)	-1,1 (-18,8, 14,7)	0,9 (-18,8, 25,4)	0,93

Gildin eru sýnd sem meðaltöl 95% vikmarka (95% ÖB) hjá körlum og konum, munur á áhrifum íhlutunar í prósentum (%) og tölfræðilegri marktækni (p-gildi); *p<0,05, ** p <0,01, *** p <0,001. Niðurstaðan er sýnd með leiðréttingum fyrir aldri þar sem gögnum var logra-varpað.
† = Hlutfall í prósentum (%) af gögnum sem var logra-varpað. LÞS = líkamsþyngdarstuðull. SPPB = hreyfifærnipróf (Short Physical Performance Battery Test). s = sekúndur.
6MW = 6 mínútna göngupróf. m = metrar. PA = dagleg hreyfing. cpm = slög á mínútu.

sókn juku bæði kynin gönguhraða sinn eftir 6-MFÞ. Sú breyting hélst stöðug til loka rannsóknar.

Í rannsókn Galvao og félaga[21] kom í ljós að eldri konur höfðu meiri möguleika til að bæta vöðvakraft sinn en karlar. Það er í takt við niðurstöður okkar þar sem aukning á vöðvakrafti í fótum var meiri hjá konum en hjá körlum eftir 6-MFÞ, þótt munur milli kynja hafi ekki verið tölfræðilega marktækur. Þá má gera ráð fyrir að lífsstílsbreytingar sem þátttakendur tileinkuðu sér meðan á íhlutun stóð og eftir að henni lauk eigi einnig drjúgan þátt í að viðhalda áunnum breytingum.[10]

Í 6MW jókst gönguvegalengd beggja kynja og munur á áhrifum þjálfunar var ekki marktækur. Rannsókn Huang og félaga[22] bendir til að slíkar niðurstöður séu staðfesting á því að auka megi þol eldri aldurshópa með markvissri þjálfun, óháð kyni. Hin jákvæðu áhrif hreyfingar á hreyfigetu og almenna heilsu eldri aldurshópa eru einnig þekkt, en draga má úr dánartíðni, sjúkdómum og örorku með reglubundinni hreyfingu.[23] Þessar niðurstöður sýna á skýran hátt tengsl markvissrar þjálfunar við aukna hreyfigetu beggja kynja. Niðurstöður grunnmælinga okkar eru einnig í takt við aðrar rannsóknir sem sýna að eldri karlar hreyfi sig meira en eldri konur.[23,24] Sé aftur á móti litið á niðurstöður í lok rannsóknar er sá munur ekki lengur til staðar. Sex mánaða íhlutun hefur að líkindum haft jákvæð áhrif á hreyfingu þessa aldurshóps, ekki síst hjá konunum.

LÞS karla og kvenna lækkaði marktækt eftir 6 mánaða þjálfun. Sú breyting varðveittist út rannsóknartímann. Rannsókn Jenkins [25] bendir á að því hærri sem LÞS er, þeim mun meiri líkur eru á að skert hreyfigeta geri vart við sig meðal eldri einstaklinga. Þá dregur úr ADL eftir því sem LÞS verður hærri.[2] Við lok rannsóknartíma var LÞS þátttakenda lægri en í upphafi rannsóknar og því má líta á 6-MFÞ sem fyrirbyggjandi þátt í að viðhalda hreyfigetu aldurshópsins, ekki síst þar sem kraftur tapaðist ekki á rannsóknartíma og hreyfigeta efldist.

Takmarkanir þessarar rannsóknar má tengja við brottfall þátttakenda sem var um 20%. Þeir sem hættu þátttöku voru marktækt eldri og ekki eins vel á sig komnir og þeir sem luku öllu rannsóknarferlinu. Helsti styrkur þessarar rannsóknar var rannsóknarsniðið. Það gaf H-2 einnig tækifæri til þátttöku í þjálfun og næringarfræðslu að loknu viðmiðunartímabili. Verklag af þessum toga í rannsóknum er viðeigandi fyrir þennan aldurshóp með tilliti til þeirrar þekkingar sem til er um minnkandi hreyfigetu með hækkandi aldri.[2] Styrkur rannsóknarinnar liggur einnig í hóflegri, einfaldri og einstaklingsmiðaðri þjálfun þar sem ákefðin var eitt lykilatriða, en hún hefur að mati sérfræðinga sterka tengingu við ávinning þjálfunar.[26]

Hin jöfnu áhrif þjálfunar á kynin, framfarir beggja kynja að lokinni 6-MFÞ og niðurstöður 12 mánuðum eftir að íhlutun lauk sýna hvað markviss þjálfun getur leitt af sér. Niðurstöðurnar sýna á skýran hátt að hægt er að hafa jákvæð áhrif á hreyfigetu þessa aldurshóps með markvissri en hóflegri þjálfun. Rannsóknin bendir eindregið til þess að þjálfun af þessum toga eigi að vera hluti af hefðbundinni heilsugæslu aldraðra þar sem líklegt er að hún skili sér í sparnaði í heilbrigðiskerfinu.[27,28] Þetta atriði á ekki síst við um eldri konur sem þurfa á meiri aðstoð og þjónustu að halda en karlar frá heilbrigðisyfirvöldum.[29,30]

Heildaráhrif rannsóknarinnar staðfesta einnig að reglubundin hreyfing og heilbrigður lífsstíll getur haft þýðingarmikið forvarnargildi til að viðhalda ADL. Íslenskir læknar og erlendir sérfræðingar styðja slíkar íhlutanir þegar þeir benda á að lýðgrunduð inngrip eða íhlutanir af þessum toga séu áhrifaríkari í lýðheilsufræðilegu tilliti en aðferðir sem byggja á áhættuskimun.[7,31]

Ályktun

Þar sem enginn marktækur munur kom í ljós á áhrifum þjálfunar á kynin er hægt að álykta að eldri karlar og konur sem eru við nokkuð góða heilsu bregðist á sambærilegan hátt við fjölþættri þjálfun og að þau geti varðveitt áunnar jákvæðar breytingar á sambærilegan hátt í allt að 12 mánuði með áframhaldandi sjálfstæðri þátttöku. Einnig má álykta að einstaklingsmiðuð þjálfunaráætlun þar sem sérstök áhersla er lögð á tíðni, tímalengd og ákefð æfinga geti aukið hreyfigetu einstaklinga af báðum kynjum sem náð hafa mjög háum aldri. Gera má ráð fyrir að þjálfun af þessum toga komi í veg fyrir ótímabæra skerðingu á hreyfigetu. Rannsóknin bendir eindregið til þess að hófleg kerfisbundin þjálfun fyrir þennan aldurshóp eigi að vera hluti af hefðbundinni heilsugæslu aldraðra þar sem líklegt er að þjálfun af þessum toga hafi áhrif á mörg líffæri og líffærakerfi[32], geti skilað sér í sparnaði í heilbrigðiskerfinu[27,28] og þannig orðið hvati fyrir lækna að ávísa hreyfingu í formi hreyfiseðla.

Þakkir

Höfundar þakka fólkinu sem tók þátt í rannsókninni fyrir skilning þess og samvinnu. Þakkir eru jafnframt færðar þeim sem unnu að rannsókninni og eftirtöldum aðilum sem styrktu hana: RANNÍS, Rannsóknasjóður Háskóla Íslands, líkams- og heilsuræktarstöðin World Class Laugar, líkams- og heilsuræktin Máttur á Selfossi, Samband sveitarfélaga á höfuðborgarsvæðinu, Hjartavernd, Heilbrigðisstofnun Suðurlands, Verkamannafélagið Hlíf í Hafnarfirði, Dvalarheimili aldraðra sjómanna (DAS) í Reykjavík, Lýðheilsustöð, mennta- og menningarmálaráðuneytið og Knattspyrnusamband Íslands.

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ENGLISH SUMMARY

The effects of 6 months' multimodal training on functional performance, strength, endurance, and body mass index of older individuals. Are the benefits of training similar among women and men?

Gudlaugsson J[1], Aspelund T[2,3], Gudnason V[3], Olafsdottir AS[1], Jonsson PV[3,4], Arngrimsson SA[1], Johannsson E[1]

Introduction: Good functional performance in elderly people greatly improves their c changes of independence and well-being. Conversely, bad functional performance can impair their capability of managing the activities of daily life.. The main goal of this study was to investigate the effects of a 6-months' multimodal training intervention on the physical performance of males and females, possible gender differences and the outcome 6 and 12 months after its completion. .

Material and methods: This study examined 71–90 year old healthy seniors (n=117) participating in the AGES Reykjavik Study. It was a randomized and controlled cross-over trial, conducted in three 6-months' phases (time-points). After enrollment and baseline assessments, the study group was divided in two. Group 1 received 6-months' training while group 2 served as a control. In the second 6 months' phase, group 1 received no formal training while group 2 did. In the third phase, neither group received training. The groups' physical conditions were assessed after each phase.

Results: After 6-months' training, 32% improvement was seen in physical activity among males ($p<0.001$) and 39% among females ($p<0.001$). In physical performance, 5% improvement was seen for males ($p<0.01$) and 7% for females ($p<0.001$). Strength increased by 8% for males ($p<0.001$) and 13% for females ($p<0.001$). For both sexes, about 10% increase was seen in dynamic balance in the 8-foot up-and-go test ($p<0.001$) and 5–6% in walking distance for both sexes in the six minutes walking test ($p<0.001$). For both sexes, body mass index decreased by about 2% ($p<0.001$). No difference was seen between the sexes.in the training results. Both sexes retained long-term effects of the training on physical performance and dynamic balance for at least 12 months.

Conclusions: Multimodal training intervention has positive effects on physical performance in older individuals, the sexes respond similarly to the training and retain achieved improvement for at least 12 months. The research indicates that moderate and systemic training for this age group could be a part of conventional health service for this age group.

Keywords: *Aging, training, functional performance, muscle strength, six-minute walking test*

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Appendix

Appendix 1

Written consent from Multimodal Training Intervention: An Approach to Successful Aging:

Heilsufarsupplýsingar

Raðnúmer: ____________

Heilsufarsupplýsingar

vegna rannsóknarinnar

Líkams- og heilsurækt aldraðra
Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða

Höfuðborgarhópur

Farið verður með allar upplýsingar sem gefnar *verða sem trúnaðarmál*

Nafn: ______________________________________ *Kennitala:* ____________________

Sími: ____________________ *GSM:* __________________

Heimili: ___________________________________ *Póstnúmer:* ________________

Bls. 1

Ágæti þátttakandi
Vinsamlegast merkið með **(X)** við rétt svar og/eða fyllið út eftir því sem við á í spurningunum hér á eftir.

1. Tekur þú einhver lyf sem læknir hefur ávísað? ( ) Já ( ) Nei

Ef svarið er **(x) Já**, þá vinsamlega skrifaðu niður nöfn þeirra lyfja sem þú tekur eða hafðu með þér lyfjakort frá heimilislækni/sjúkrahúsi:

____

____

____

____

2. Hefur þú einhvern tíma þurft að taka steralyf? ( ) Já ( ) Nei

Ef svarið er **(x) Já**, þá hvenær; ____________________ og

hve lengi;____________________

3. Hefur læknir einhvern tíma sagt þér að þú værir með krabbamein eða hefurðu einhvern tíma verið til meðferðar vegna þess?
( ) Já ( ) Nei

Ef svarið er **(x) Já**, þá vinsamlega greinið frá hvenær, hvenær meðferð lauk, og hvaða krabbamein

Hvenær?____

Hvenær meðferð lauk?______________________________________

Hvaða krabbamein? _______________________________________

4. Hefur þú einhvern tíma fengið heilablóðfall? ( ) Já ( ) Nei

Ef svarið er **(x) Já**, þá **hvenær?**

____

Bls. 2

5. Hefur læknir einhvern tíma sagt þér að þú hefðir einhvern eftirtalinna sjúkdóma eða sjúkdómaflokka?
   Merkið **(x)** við það sem við á og **<u>strikið undir orðið</u>** ef slíkt á við:
   ( ) Hár blóðþrýstingur
   ( ) Hjartasjúkdóm (hjartaáfall, hjartabilun, hjartaöng, hjartastækkun)
   ( ) Lungnasjúkdóm (lungnateppu, berkla, lungnabólgur, lungnaþembu)
   ( ) Nýrnasjúkdóm
   ( ) Lifrarsjúkdóm
   ( ) Meltingarsjúkdóm (magasár, magablæðingar)
   ( ) Stoðkerfissjúkdóm (vöðvar, sinar, bein, gigt)
   ( ) Innkirtlasjúkdóm (sykursýki, skjaldkirtilssjúkdóm)
   ( ) Aðrir alvarlegir sjúkdómar:

____

____

____

5. Hvert er nafn á heimilislækni þínum:

   Nafn læknis: ________________________________

6. Gefur þú leyfi um að læknir/læknar rannsóknarinnar fái að hafa samband við þinn heimilislækni ef þeir telja það nauðsynlegt? ( ) Já ( ) Nei

Ef þú hefur spurningar um rétt þinn sem þátttakandi í vísindarannsókn eða vilt hætta þátttöku í rannsókninni getur þú snúið þér til Vísindasiðanefndar, Vegmúla 3, 108 Reykjavík. Sími: 551-7100, fax: 551-1444.

Kærar þakkir
f.h. rannsakenda, Janus Guðlaugsson

Bls. 3

Appendix 2

Written consent from Multimodal Training Intervention: An Approach to Successful Aging:

Ýmsar mælingar – Eyðublað til mælinga

Raðnúmer: ____________

Líkams- og heilsurækt aldraðra

Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða

- Ýmsar mælingar -

- Höfuðborgarhópur -

Nafn:	Kennitala:
Staður:	Dagsetning:

2.3.2014 1

Raðnúmer:

Mæling 1

Blóðþrýstingur	Efri mörk: ________	Neðri mörk: ________

Mæling 2

Hvíldarpúls	Hvíldarpúls: ________

Mæling 3

Ummál mittis: ________ sm	**Ummál mjaðma: ________ sm**	(MMS) **WHR: ________**

Mæling 4

Hæð: ________ sm	**Þyngd: ________ kg**	(LÞS) **BMI: ________**

Mæling 5

Teygt yfir hægri fót **Setið og teygt fram: ________ sm**	Teygt yfir vinstri fót **Setið og teygt fram: ________ sm**

Mæling 6

Teygt aftur fyrir bak: ________ sm Teygt hægri - vinstri (hægri að ofan – vinstri að neðan)	**Teygt aftur fyrir bak: ________ sm** Teygt vinstri - hægri (vinstri að ofan – hægri að neðan)

Mæling 7

Staðið upp úr stól, **gengið kringum keilu (8 fet)** **og til baka afur og sest niður á stól:**	**1. ferð** **________ sek**	**2. ferð** **________ sek**

2.3.2014 2

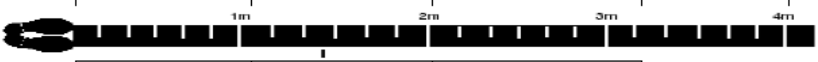
Raðnúmer:

Mæling 8

SPPB-prófið	Stig

Jafnvægi	Tími	Stigagjöf	
Samhliða	**Tími: __________sek** **Reyndi/Gat ekki ( )** **Neitaði ( )**	**< 9,99 = 0 stig** **> 10 sek = 1 stig > Áfram**	
½ samhliða	**Tími: __________sek** **Reyndi/Gat ekki ( )** **Neitaði ( )**	**< 10 sek = 1 stig** **> 10 sek = Áfram í hæl - Tá**	Stig: _______
Hæll – Tá	**Tími: __________sek** **Reyndi/Gat ekki ( )** **Neitaði ( )**	**0–2,99 sek = 2 stig** **3–9,99 sek = 3 stig** **> 10 sek = 4**	

4 m ganga	Besti tími	Stigagjöf	
Tími 1: _____sek **Tími 2: _____sek**	**Besti tím:** **__________sek**	**Getur ekki = 0 stig** **> 8,70 sek = 1 stig** **6,31–8,70 sek = 2 stig** **4,82–6,20 sek = 3 stig** **< 4,82 sek = 4 stig**	Stig: _______



Standa upp úr stól	Tími	Stigagjöf	
Getur staðið upp án aðstoðar: **Já ( )** **Nei ( )** **Ef nei = 0 stig**	**Tími:** **__________sek** 	**> 60 sek, getur ekki = 0 stig** **> 16,7 sek = 1 stig** **13,70–16,69 sek = 2 stig** **11,20–13,69 sek = 3 stig** **≤ 11,19 sek = 4 stig**	Stig: _______

Samtals stig	__________

2.3.2014 3

Raðnúmer:

Mæling 9

Setið á stól með iljar í gólf og 90° beygju um olnboga (grip 3 kk og 2 kvk)

Handstyrkur	kg

Stilling (X): ( )1 ( )2 ( )3 ( )4

Svara með (X): Ég er ( ) rétthent/-ur ( ) örvhent/-ur

Handstyrkur (hægri):	1. _____ kg	2. _____ kg	3. ____ kg	Best._____ kg
Handstyrkur (vinstri):	1. _____ kg	2. _____ kg	3. ____ kg	Best._____ kg

Mæling 10

6 mínútna göngupróf	Ath. Vatnsglas Ath. Stóla

Þátttakandi sest niður fyrir 6 mín. göngu, slakar á í 2 mínútur og hvíldarpúls fundinn:

0. mín:	Hvíldarpúls fyrir 6 mín. próf	Hvíldarpúls:

Fyrirmæli:

- Að ganga með jöfnum hraða, eins hratt og þú getur, í 6 mínútur, án þess að hlaupa.
- Þú verður látinn vita með tveggja mínútna millibili hvernig tímanum líður

0 – 2 mín:	Umferðir * :	+ metrar:	
2 – 4 mín:	Umferðir * :	+ metrar:	
4 – 6 mín:	Umferðir * :	+ metrar:	Lokapúls:

* 1 umferð = 16 metrar

Þátttakandi sest niður að lokinni 6 mín. göngu >

7. mín:	(púls fundinn e. 1 mín (+6 mín))	Púls e. 7. mín:

Niðurstaða:	Heildarvegalengd (m)	**Metrar**: _____________ **m**

2.3.2014 4

Appendix 3

Written consent from Multimodal Training Intervention: An Approach to Successful Aging:

Upplýst samþykki, boðsbréf og upplýsingar um rannsóknina

Raðnúmer: ___________

Upplýst samþykki,

boðsbréf og upplýsingar

um rannsóknina

Líkams- og heilsurækt aldraðra

Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða

Höfuðborgarhópur

Nafn:____________________________________Kennitala: __________________

Staður.:___________________________________ Dags.: ____________________

1

Boðsbréf og upplýsingar

um rannsóknina

Líkams- og heilsurækt aldraðra
Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða

Þátttakendur úr Öldrunarrannsókn Hjartaverndar - Höfuðborgarhópur

Kæri þátttakandi

Apríl, 2008

Heilsufarsvandamál sem tengjast lifnaðarháttum fólks hafa aukist til mikilla muna á undanförnum árum og má í því sambandi nefna aukna kyrrsetu og áhyggjur lækna um ofþyngd eldri aldurshópa hér á landi. Með því að gera sér grein fyrir líkamsástandi og heilsufari íslenskra borgara er auðveldara að grípa til fyrirbyggjandi aðgerða og um leið minnka líkur á heilsufarsvandamálum í framtíðinni.

Þátttakendur í rannsókninni eru einstaklingar 70 ára og eldri úr Öldrunarrannsókn Hjartaverndar. Viðfangsefni rannsóknarinnar er að kanna líkamsástand þessa hóps og finna út hvort sértækar aðgerðir sem stuðla að breyttu mataræði og aukinni hreyfingu hafi áhrif á holdarfar, þol, styrk, mataræði og blóðgildi hjá eldri einstaklingum á sex mánaða rannsóknartímabili. Einnig á að kanna hvort og hve vel íhlutun hefur tekist þegar til lengri tíma er litið. Því verða sömu mælingar endurteknar að sex og tólf mánuðum liðnum hjá íhlutunarhópum. Þátttakendur rannsóknar taka þátt í 26 vikna (6 mánaða) þjálfunaráætlun að undangengnum mælingum á ýmsum þáttum sem tengdir eru heilsufari. Þjálfunaráætlun er m.a. fólgin í að þol- og styrktaræfingum undir leiðsögn sérfræðinga þrjá til fjóra daga vikunnar auk þess sem þátttakendur stunda sjálfstæða gönguþjálfun (þolþjálfun) eftir fyrirfram gefnum leiðbeiningum.

Með bréfi þessu óska rannsakendur frá Kennaraháskóla Íslands, Háskóla Íslands og Hjartavernd eftir samþykki þínu fyrir þátttöku í rannsókninni sem munu standa yfir á árunum 2008 til 2009.

Ábyrgðarmaður rannsóknar er Dr. Vilmundur Guðnason, prófessor og forstöðulæknir rannsóknastöðvar Hjartaverndar. Sími: 5351800. Netfang: *v.gudnason@hjarta.is*

Ef þið hafið áhuga á að taka þátt í rannsókninni óskum við eftir því að þið kynnið ykkur verkþætti hennar vel og hafið síðan samband við ábyrgðamann rannsóknar eða aðra rannsakendur. Við munum einnig hafa samband við ykkur vegna upplýsts samþykkis innan þriggja daga frá móttöku þessa bréfs. Þátttaka ykkar er mjög mikilvæg og koma nöfn ykkar hvergi fram við úrvinnslu eða birtingu rannsóknarinnar. Farið með allar upplýsingar sem trúnaðarmál.

Ef þú hefur spurningar um rétt þinn sem þátttakanda í vísindarannsókn eða vilt hætta þátttöku í rannsókninni getur þú snúið þér til Vísindasiðanefndar, Vegmúla 3, 108 Reykjavík. Sími: 551 7100 og fax: 551 1444.

Undirskrift þátttakanda

Dags.:_______________ Nafn:____

Með þökk og kærri kveðju,

Vilmundur Guðnason

Dr. Vilmundur Guðnason, prófessor

Aðrir rannsakendur:

- Dr. Erlingur Jóhannsson, prófessor við Kennaraháskóla Íslands. Sími: 4803900. Netfang: erljo@khi.is
- Dr. Sigurbjörn Árni Arngrímsson, dósent við Kennaraháskóla Íslands. Sími: 4803908. Netfang: sarngrim@khi.is
- Pálmi V. Jónsson, dósent við Háskóla Íslands og lyf- og öldrunarlæknir. Sími: 55439410. Netfang: palmivj@landspitali.is
- Dr. Anna Sigríður Ólafsdóttir, næringarfræðingur og lektor við Kennaraháskóla Íslands. Sími: 5633915. Netfang: annasigga@khi.is
- Janus Guðlaugsson, M.Ed.-íþróttafræðingur, ph.d.-nemi og aðjúnkt við Kennaraháskóla Íslands. Sími: 8980786. Netfang: janus@khi.is
- Elísabet Kristjánsdóttir, B.S. íþróttafræðingur og meistaranemi við Kennaraháskóla Íslands. Sími: 8475212
- Sigurður Örn Gunnarsson, B.S.-sjúkraþjálfari og meistaranemi við Kennaraháskóla Íslands. Sími: 8650128

2

Verkþættir rannsóknarinnar

Líkams- og heilsurækt aldraðra

Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða

Þátttakendur úr Öldrunarrannsókn Hjartaverndar - Höfuðborgarhópur

Markmið rannsóknarinnar, *Líkams- og heilsurækt aldraðra - Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða*, er að kanna heilsufar og holdafar eldri einstaklinga og tengsl þessara þátta við hreyfingu, styrk og þol þátttakenda. Auk þess verður mataræði rannsakað og áhrif framangreindra atriða á breytur í blóði, holdarfari og beinvef kannaðar. Til að auka vísindalegt gildi enn frekar verða upplýsingar tengdar við fyrri mælingar úr gögnum Öldrunarrannsóknar Hjartaverndar. Rannsóknin er unnin í nánu samstarfi við sérfræðinga Hjartaverndar og lyf- og öldrunarlækna á Landspítala – Háskólasjúkrahúsi.

Öllum þátttakendum verður boðið til fræðslufunda um góða lífshætti og hollt líferni meðan á rannsókn stendur. Þá munu þátttakendur ekki þurfa að greiða neitt fyrir þátttöku í rannsókninni, þetta á jafnt við um ferðir í mælingar á rannsóknartíma og aðgengi að heilsurækt og þjálfun. Vísindasiðanefnd og Persónuvernd hafa samþykkt framkvæmd rannsóknarinnar. Þið getið samþykkt þátttöku í öllum þáttum rannsóknarinnar eða aðeins hluta hennar, þ.e. hafnað þátttöku í þolprófi og/eða blóðprufu þó samþykkt sé þátttaka í öðrum mælingum. Þið getið ákveðið hvenær sem er og fyrirvaralaust að hætta við þátttöku í rannsókninni, að hluta eða öllu leyti, og verður þá upplýsingum eytt um ykkur. Hafið þið einhverjar spurningar eða athugasemdir er ykkur velkomið að hringja í einhvern undirritaðan. Þeir aðilar sem ekki skila inn upplýstu samþykki verða ekki þátttakendur í rannsókninni.

Ávinningur þessarar rannsóknar er fyrst og fremst þekkingarlegs eðlis í þeim skilningi að ef íhlutunaraðgerðir verða jákvæðar fyrir íhlutunarhóp þá munu þær upplýsingar gefa vísbendingar um til hvaða aðgerða sé hægt að grípa til að bæta velferð og heilsu eldri aldurshópa. Áhætta vegna þátttöku er ekki meiri en við hefðbundna læknisskoðun og blóðsýnatöku.

Þátttaka í rannsókninni felst í eftirfarandi 7 þáttum:

1. Á allra næstu dögum munum við hafa samband við þig (þátttakendur) og boða ykkur til mælinga þar sem mældur verður blóðþrýstingur, hæð og þyngd auk þess sem ummál mittis og mjaðma verður einnig mælt og skráð. Hreyfifærni verður mæld með einföldu hreyfifærniprófi auk þess sem liðleiki verður mældur. Líkamssamsetning verður mæld í sérstöku mælitæki og blóðsýni tekið og mælt.

2. Þol verður mælt með stöðluðu sex mínútna gönguprófi. Styrkur verður mældur með sérhönnuðum styrktarmælitækum, annars vegar fyrir vöðva fótleggja og hins vegar fyrir gripstyrk í höndum. Fyllsta öryggis verður gætt meðan á prófi stendur. Þá verða heilsutengd lífsgæði könnuð með spurningalista.

3. Þú verður beðinn um að skrá mat og drykk í 3 daga strax eftir að þessum mælingum lýkur (liður 1 og 2). Meta á magn á einfaldan hátt samkvæmt leiðbeiningum sem fylgja matardagbók. Haldinn verður kynningarfundur fyrir þátttakendur um fæðuskráninguna áður en þið byrjið að skrá og rannsóknartímabil hefst. Á fundinum verður æfinga-og matardagbókum dreift. Unnið verður úr gögnum með tölvuforriti Rannsóknastofu í næringarfræði sem inniheldur íslenskan gagnagrunn um efnainnihald matvæla.

4. Dagleg hreyfing verður mæld með hröðunarmælitæki sem þið munuð bera á ykkur í 5 daga. Tækið er á stærð við armbandsúr eða örlítið stærra og skráir í minni allar hreyfingar á hreyfingu. Tækið verður sett á belti um mittið eða á buxnastreng. Mikilvægt er að þið skráið á sérstakt blað hvenær þið eruð ekki með tækið á ykkur ef þið einhverra hluta vegna berið það ekki allan tímann. Eftir fimm daga munum við fá tækin til baka hjá ykkur.

5. Rannsókn á lífsýni, blóðprufa, er tekin eftir föstu fljótlega að morgni hjá Hjartavernd. Strax að lokinni blóðprufu fáið þið næringu (ávaxtasafa og brauð) eða nesti sem þið takið með ykkur sér ef þið viljið það frekar og síðan verður ykkur ekið heim ef þið óskið þess. Þið fáið sérstaka tilkynningu daginn fyrir blóðprufuna og þið minnt á að mæta fastandi til Hjartaverndar

6. Mæling á líkamssamsetningu, holdarfari og beinþéttni verður mæld í sérstöku mælitæki, Lunar iDXA. Gera má ráð fyrir að mælingin taki um 15 mínútur. Þú liggur á bekk á meðan rannsóknin fer fram og líkaminn er skannaður. Mjög takmörkuð geislun fylgir þessari mælingu.

7. Þátttakendur í rannsókninni taka þátt í 26 vikna (6 mánaða) þjálfunaráætlun að undangengnum framangreindum mælingum (liðir 1–6 hér að framan). Þjálfunaráætlun er m.a. fólgin í að æfa styrktar- og þolþjálfun undir leiðsögn sérfræðinga þrjá til fjóra daga vikunnar og stunda sjálfstæða gönguþjálfun eftir fyrirfram gefnum leiðbeiningum. Styrktar- og þolþjálfun verður stunduð í heilsuræktarstöðinni Mætti á Selfossi auk þess sem gönguþjálfun verður stunduð utandyra á árinu 2008 í nálægð þinnar búsetu. Gengið er út frá því að þú getir séð þér fært að mæta til þátttöku í um 80% af áætluðum þjálfunartíma en einnig að þú sjáir þér fært um að stunda sjálfstæða þolþjálfun samkvæmt fyrirfram ákveðinni þjálfunar- og rannsóknaráætlun.

Verkþættir 1, 2, 3, 4 og 7 verða framkvæmdir í heilsurækt World Class-Laugum í Reykjavík, heilsuræktarstöðinni Mætti á Selfossi og íþróttahúsi Kennaraháskóla Íslands að Laugarvatni en verkþættir 5–6 verða framkvæmdir í Hjartavernd, Holtasmára 1, Kópavogi og Heilbrigðisstofnun Suðurlands á Selfossi. Rannsóknin hefur verið samþykkt af Vísindasiðanefnd og Persónuvernd.

Upplýst samþykki

Með undirritun á *upplýstu samþykki*, sem er á sérstökum blöðum, samþykkir þú eftirfarandi þátttöku:

b. Að taka þátt í þjálfun og þjálfunaráætlun sem stendur yfir í 26 vikur, sjá 7. lið hér að framan.
c. Að taka þátt í þeim mælingum sem fram koma í liðum 1 til 5 hér að framan.
d. Að taka þátt í iDXA-mælingu sem er skýrður út í 6. lið hér að ofan.
e. Að taka þátt í gjöf á blóðsýni þar sem þú annað hvort vilt láta eyða lífsýnum og upplýsingum, sjá A-hluta í upplýstu samþykki og hér að neðan eða leyfa að varðveita það í Lífsýnasafni rannsóknaverkefna Hjartaverndar, sjá B hluta í upplýstu samþykki og hér að neðan. Þú ert því vinsamlegast beðinn um að undirrita upplýsta samþykkið og annað hvort A- eða B-hluta þess.
   - **Útskýring á A-hluta í upplýstu samþykki**
     Með því að undirrita samþykkisblað **A** lýsir þú því yfir að blóðsýni frá þér megi einungis nota til þeirrar rannsóknar sem þar er tilgreind. Í því tilfelli yrði lífsýni, erfðaefni og dulkóða sem tengdi þig við rannsóknarniðurstöður eytt að rannsókn lokinni.
   - **Útskýring á B-hluta í upplýstu samþykki**
     Með því að undirrita samþykkisblað **B**, heimilar þú, í samræmi við 4. gr. rg. 134/2001, ábyrgðaraðilum þessarar rannsóknar að varðveita undir kóða lífsýni og erfðaefni úr þér í Lífsýnasafni Rannsóknaverkefna Hjartaverndar og að það megi nota til rannsókna sem hlotið hafa umfjöllun og samþykki Persónuverndar og Vísindasiðanefndar.

Lífsýnasafn rannsóknarverkefna Hjartaverndar

Lífsýnasafn Rannsóknarverkefna Hjartaverndar hefur hlotið tilskilin leyfi frá Heilbrigðisráðuneytinu. Ábyrgðamaður safnsins er Dr. Vilmundur Guðnason, forstöðulæknir Hjartaverndar, Holtasmára 1, 201 Kópavogi. Lífsýnasafnið samanstendur af blóðsýnum, þvagsýnum, munnvatnssýnum, frumum og erfðaefnissýnum sem þátttakendur í rannsóknum á vegum Hjartaverndar hafa valið að láta geyma til frekari rannsókna. Markmið rannsóknanna er að leita orsaka og lækninga við sjúkdómum. Safnstjórn er einnig heimilt sbr. 9. gr. laga nr. 110/2000, um lífsýnasöfn að veita aðgang að lífsýnum til notkunar við gæðaeftirlit, aðferðarþróun og kennslu og mögulegt er að Persónuvernd og Vísindasiðanefnd geti heimilað notkun lífsýna í öðrum tilgangi en ætlað var þegar þau voru tekin enda mæli brýnir hagsmunir með því og ávinningurinn vegi þyngra en hugsanlegt óhagræði fyrir lífsýnagjafa eða aðra aðila. Sýni frá þér úr þessari rannsókn verða þó ekki notuð til annarra rannsókna nema með samráði við ábyrgðamann rannsóknarinnar. Þátttakendur geta hvenær sem er fengið almennar upplýsingar um hvaða rannsóknir eru stundaðar hjá Hjartavernd á heimasíðu fyrirtækisins http://www.hjartavernd.is eða í síma 5351800. Starfsreglur lífsýnasafnsins eru lífsýnagjafa aðgengilegar.

Upplýst samþykki
um þátttöku í rannsókninni
Líkams- og heilsurækt aldraðra

Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða

Rannsóknarliðir 1 – 7

Sjá sérstök samþykkisblöð fyrir 5. lið, A- og B-hluta

_______________________________ ______________

Nafn þátttakanda Kennitala

Rannsóknarliðir 1, 2, 3, 4, 5 og 7.: Hreyfifræni, þol og styrkur, spurningalisti um mataræði og lífsgæði, dagleg hreyfing sem og mæling þátta í blóði

Með undirskrift minni hér fyrir neðan votta ég vilja minn til þátttöku í fyrstu fimm liðum rannsóknar og að mér hefur verið gefinn nægur tími til að kynna mér efni þessarar samþykkisyfirlýsingar, liðir 1, 2, 3, 4, 5 og 7, og fengið viðunandi svör við spurningum mínum.

Ég, undirritaður, samþykki þátttöku mína í fyrstu 5 þáttum og þætti 7 ofangreindrar rannsóknar.

Samþykki þátttakenda fyrir rannsóknarliðum 1, 2, 3, 4, 5 og 7:

Dags:________________;_______________________________________

(undirskrift)

Rannsóknarliður 6: DEXA-mæling

Með undirskrift minni hér fyrir neðan votta ég vilja minn til þátttöku í 5. lið rannsóknar og að mér hefur verið gefinn nægur tími til að kynna mér efni þessarar samþykkisyfirlýsingar, 5. liður um iDEXA-mælingar og fengið viðunandi svör við spurningum mínum.

Samþykki þátttakenda fyrir rannsóknarlið 6:

Dags:________________;_______________________________________

(undirskrift)

Dagsetning og undirskrift rannsakanda sem leggur yfirlýsinguna fyrir:

Dags.:______________ Nafn:____

5

Upplýst samþykki
um þátttöku í rannsókninni
Líkams- og heilsurækt aldraðra

Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða

Rannsóknarliður 5: Samþykkisblað B-hluti

____ ________________
Nafn þátttakanda Kennitala

Með undirskrift minni hér fyrir neðan votta ég vilja minn til þátttöku í ofangreindri rannsókn og að mér hefur verið gefinn nægur tími til að kynna mér efni þessarar samþykkisyfirlýsingar og fengið viðunandi svör við spurningum mínum.

Í samræmi við 4. gr. rg. 134/2001 veiti ég ábyrgðaraðilum þessarar rannsóknar leyfi til að varðveita blóðsýni og erfðaefni úr mér í Lífsýnasafni Rannsóknaverkefna Hjartaverndar undir kóða. Lífsýni má nota til rannsókna sem hlotið hafa umfjöllun og samþykki Persónuverndar og Vísindasiðanefndar.

Samþykki þátttakenda fyrir B-hluta:

Dags:________________;____
(undirskrift)

Dagsetning og undirskrift rannsakanda sem leggur yfirlýsinguna fyrir og staðfestir að eðli og tilgangur ofangreindrar rannsóknar hefur verið kynntur fyrir ofangreindum einstaklingi í samræmi við lög og reglur um vísindarannsóknir:

*Dags.:*______________ *Nafn:*____

7

Upplýsingar
vegna upplýsts samþykkis fyrir þátttöku í rannsókninni

Líkams- og heilsurækt aldraðra
Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða

1. Með undirskrift undir upplýst samþykki staðfestir þátttakandi þá ákvörðun sína að taka þátt í rannsókninni *Líkams- og heilsurækt aldraðra – Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða* á vegum rannsakanda við Kennaraháskóla Íslands, Háskóla Íslands og sérfræðinga á vegum Hjartaverndar.

2. Þátttakandi staðfestir að hafa lesið og skilið efnislegt innihald þessarar samþykkisyfirlýsingar og vottar að honum hafi gefist tækifæri til að kynna sér meðfylgjandi upplýsingar og verkþætti rannsóknarinnar, þar sem fjallað er um tilgang og framkvæmd hennar. Ef Hjartavernd hefur að geyma upplýsingar um þátttakanda úr eldri gögnum, þá er honum einnig ljóst að þær upplýsingar verða einnig notaðar til að tengja við niðurstöður rannsókna á lífsýnum. Þátttakandi hefur fengið tækifæri til að spyrja nánar um þau atriði sem honum voru ekki ljós og hefur fengið viðunandi svör við spurningum sínum.

3. Þátttakandi skuldbindur þátttöku sína því skilyrði að allar rannsóknir sem kunna að verða gerðar á blóðsýnum eða öðrum upplýsingum um hann séu í samræmi við gildandi lög og reglur um vísindarannsóknir á fólki og að rannsóknir og öll meðferð upplýsinga uppfylli kröfur Persónuverndar og Vísindasiðanefndar enda séu engar rannsóknir gerðar án samþykkis þessara aðila.

4. Geislaálag vegna þátttöku í rannsókninni er sambærileg við náttúrulega bakgrunnsgeislun á Íslandi í 10 ár. Náttúruleg bakgrunnsgeislun er í öllu okkar umhverfi. Hún kemur frá himingeimnum, jarðskorpunni og geislavirkum efnum í líkama okkar. Þessi geislun er lítil á Íslandi og mun minni enn annarstaðar á Norðurlöndunum. Það skal einnig haft í huga, að teknu tilliti til aldurs þíns (yfir 50 ár), þá hafa sérfræðingar í geislavörnum ályktað að áhætta vegna geislaálags í rannsókninni sé minni miðað við ef almennt þýði tæki þátt. Miðað við þá geislun sem hér um ræðir er það mat Geislavarna ríkisins að áhætta vegna þátttöku í rannsókninni sé mjög lítil, sbr. það sem að ofan segir.

5. Þátttakandi staðfestir skilning sinn á eðli þeirrar áhættu sem er því samfara að taka þátt í rannsókninni.

6. **Að hafna eða hætta við þátttöku**
   Þér er í sjálfsvald sett hvort þú veljir að taka þátt í þessari rannsókn. Þeir sem skrifað hafa undir upplýst samþykki, hvort heldur A eða B hluta yfirlýsingarinnar, geta hvenær sem er hafnað þátttöku og dregið samþykki sitt til baka án skýringa og án nokkurra eftirmála. Þátttakendur geta jafnframt farið fram á að sýnum og upplýsingum um þá sé eytt. Hvorugt mun hafa áhrif á þá meðferð sem þú hlýtur hjá rannsóknaraðilum. Tilkynningum um úrsögn úr rannsókn og/eða lífsýnasafninu skal koma á framfæri við ábyrgðamann eða Vísindasiðanefnd. Þeir sem hafna þátttöku geta ekki farið fram á að afleiddar upplýsingar, niðurstöður eða mælingar sem þá þegar eru orðnar til og stafa frá rannsóknum á lífsýnum þeirra og /eða upplýsingum, sé eytt. Slíkt kæmi í veg fyrir að hægt væri að staðfesta fengnar niðurstöður og gæti eyðilagt fyrir þátttöku annarra.

7. Ef þú hefur spurningar varðandi rétt þinn sem þátttakandi í rannsókninni getur þú snúið þér til Vísindasiðanefndar, Vegmúla 3, 108 Reykjavík. Sími 551 7100, fax 551 1444.

Samþykkisyfirlýsingar eru í tveimur eintökum og heldur þátttakandi eftir öðru eintakinu ásamt eintaki af upplýsingablaði og bæklingi um rannsóknina. Hitt eintakið varðveitir ábyrgðarmaður rannsóknarinnar, Dr. Vilmundur Guðnason.

Vilmundur Guðnason
Dr. Vilmundur Guðnason, prófessor

Upplýst samþykki
um þátttöku í rannsókninni
Líkams- og heilsurækt aldraðra

Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða

<u>Rannsóknarliður 5: Samþykkisblað A-hluti</u>

____ ________________
Nafn þátttakanda Kennitala

Með undirskrift minni hér fyrir neðan votta ég vilja minn til þátttöku í ofangreindri rannsókn og að mér hefur verið gefinn nægur tími til að kynna mér efni þessarar samþykkisyfirlýsingar og fengið viðunandi svör við spurningum mínum.

Við lok ofangreindrar rannsóknar krefst ég þess að sýnum sem frá mér hefur verið safnað sé eytt og má hvorugt nota til annarrar rannsóknar en þeirrar sem ég hef samþykkt hér að ofan. Jafnframt verði kóða sem gerir kleift að rekja niðurstöður rannsókna til mín eytt.

Samþykki þátttakenda fyrir A-hluta:

Dags:________________;____
(undirskrift)

Dagsetning og undirskrift rannsakanda sem leggur yfirlýsinguna fyrir og staðfestir að eðli og tilgangur ofangreindrar rannsóknar hefur verið kynntur fyrir ofangreindum einstaklingi í samræmi við lög og reglur um vísindarannsóknir:

*Dags.:*______________ *Nafn:*____

6

Upplýsingar
vegna upplýsts samþykkis fyrir þátttöku í rannsókninni

Líkams- og heilsurækt aldraðra
Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða

1. Með undirskrift undir upplýst samþykki staðfestir þátttakandi þá ákvörðun sína að taka þátt í rannsókninni *Líkams- og heilsurækt aldraðra – Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða* á vegum rannsakanda við Kennaraháskóla Íslands, Háskóla Íslands og sérfræðinga á vegum Hjartaverndar.

2. Þátttakandi staðfestir að hafa lesið og skilið efnislegt innihald þessarar samþykkisyfirlýsingar og vottar að honum hafi gefist tækifæri til að kynna sér meðfylgjandi upplýsingar og verkþætti rannsóknarinnar, þar sem fjallað er um tilgang og framkvæmd hennar. Ef Hjartavernd hefur að geyma upplýsingar um þátttakanda úr eldri gögnum, þá er honum einnig ljóst að þær upplýsingar verða einnig notaðar til að tengja við niðurstöður rannsókna á lífsýnum. Þátttakandi hefur fengið tækifæri til að spyrja nánar um þau atriði sem honum voru ekki ljós og hefur fengið viðunandi svör við spurningum sínum.

3. Þátttakandi skuldbindur þátttöku sína því skilyrði að allar rannsóknir sem kunna að verða gerðar á blóðsýnum eða öðrum upplýsingum um hann séu í samræmi við gildandi lög og reglur um vísindarannsóknir á fólki og að rannsóknir og öll meðferð upplýsinga uppfylli kröfur Persónuverndar og Vísindasiðanefndar enda séu engar rannsóknir gerðar án samþykkis þessara aðila.

4. Geislaálag vegna þátttöku í rannsókninni er sambærileg við náttúrulega bakgrunnsgeislun á Íslandi í 10 ár. Náttúruleg bakgrunnsgeislun er í öllu okkar umhverfi. Hún kemur frá himingeimnum, jarðskorpunni og geislavirkum efnum í líkama okkar. Þessi geislun er lítil á Íslandi og mun minni enn annarstaðar á Norðurlöndunum. Það skal einnig haft í huga, að teknu tilliti til aldurs þíns (yfir 50 ár), þá hafa sérfræðingar í geislavörnum ályktað að áhætta vegna geislaálags í rannsókninni sé minni miðað við ef almennt þýði tæki þátt. Miðað við þá geislun sem hér um ræðir er það mat Geislavarna ríkisins að áhætta vegna þátttöku í rannsókninni sé mjög lítil, sbr. það sem að ofan segir.

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6. **Að hafna eða hætta við þátttöku**
   Þér er í sjálfsvald sett hvort þú veljir að taka þátt í þessari rannsókn. Þeir sem skrifað hafa undir upplýst samþykki, hvort heldur A eða B hluta yfirlýsingarinnar, geta hvenær sem er hafnað þátttöku og dregið samþykki sitt til baka án skýringa og án nokkurra eftirmála. Þátttakendur geta jafnframt farið fram á að sýnum og upplýsingum um þá sé eytt. Hvorugt mun hafa áhrif á þá meðferð sem þú hlýtur hjá rannsóknaraðilum. Tilkynningum um úrsögn úr rannsókn og/eða lífsýnasafninu skal koma á framfæri við ábyrgðamann eða Vísindasiðanefnd. Þeir sem hafna þátttöku geta ekki farið fram á að afleiddar upplýsingar, niðurstöður eða mælingar sem þá þegar eru orðnar til og stafa frá rannsóknum á lífsýnum þeirra og /eða upplýsingum, sé eytt. Slíkt kæmi í veg fyrir að hægt væri að staðfesta fengnar niðurstöður og gæti eyðilagt fyrir þátttöku annarra.

7. Ef þú hefur spurningar varðandi rétt þinn sem þátttakandi í rannsókninni getur þú snúið þér til Vísindasiðanefndar, Vegmúla 3, 108 Reykjavík. Sími 551 7100, fax 551 1444.

Samþykkisyfirlýsingar eru í tveimur eintökum og heldur þátttakandi eftir öðru eintakinu ásamt eintaki af upplýsingablaði og bæklingi um rannsóknina. Hitt eintakið varðveitir ábyrgðarmaður rannsóknarinnar, Dr. Vilmundur Guðnason.

Vilmundur Guðnason

Dr. Vilmundur Guðnason, prófessor

8

Raðnúmer: _______

Upplýst samþykki

Samþykkisyfirlýsing um þátttöku í rannsókninni

Líkams- og heilsurækt aldraðra – Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða

Nafn þátttakanda: ______________________________

Kennitala þátttakanda: ______________________________

Ég undirrituð/undirritaður samþykki þátttöku mína í rannsókn Janusar Guðlaugssonar, íþróttafræðings og leiðsögukennara hans, dr. Erlings Jóhannssonar, dr. Sigurbjörns Árna Arngrímssonar og Pálma V. Jónssonar, lyf- og öldrunarlæknis, á Líkams- og heilsurækt aldraðra – Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða.

Þátttaka mín í rannsókninni felst í því að taka þátt rannsóknarverkefni samkvæmt áætlun sem mér hefur verið kynnt og að halda dagbók um líkams- og heilsurækt mína á rannsóknartíma. Áður en rannsóknin hefst mun ég fara í nokkur próf/mælingar þar sem athuguð verður heilsa mín, líkamleg færni, líkamssamsetning, beinþéttni og blóðinnihald skoðað. Auk þessa verða lífsgæði metin og upplýsingum safnað um aldur, kyn, búsetu og fleiri þætti sem mér hafa verið kynnt. Þessi próf verða síðan endurtekin í lok 26 vikna þjálfunartíma og síðan aftur 52 vikum eftir að þjálfunartíma lýkur.

Einnig verður lagt fyrir mig próf, hreyfifræðipróf, í upphafi þjálfunartíma til að meta það hvort heilsa mín leyfi þátttöku í þessari rannsókn. Pálmi V. Jónsson og Ólafur Þór Gunnarsson, lyf- og öldrunarlæknar, munu fara yfir heilsufarsupplýsingar þátttakenda og meta hvort mælst sé með þátttöku eða ekki.

Mér hefur verið tjáð að ef slys verður innandyra, á æfingastað rannsóknar, sem sem rekja má beint til gáleysis rannsakanda eða vanbúnaðar að einhverju leiti, er æfingastaður tryggður fyrir slíku. Ég er annars með mína eigin tryggingu og á eigin ábyrgð við æfingar.

Ávinningur og/eða áhætta samfara rannsókninni hefur verið útskýrð fyrir mér. Mér er ljóst að ég get hvenær sem er dregið þátttöku mína í rannsókninni til baka án allra eftirmála af hálfu rannsakenda. Ég geri mér grein fyrir að allar upplýsingar sem safnað verður saman vegna rannsóknarinnar verða geymdar og notaðar til vinnu við niðurstöður. Ég samþykki að niðurstöður rannsóknar megi tengja við skrár Hjartaverndar, svo og sjúkraskrá og að geyma megi sýni/blóðvökva (plasma) sem sér sýni til seinni tíma.

Farið verður með allar upplýsingar sem trúnaðarmál og þær verða ekki persónugreinanlegar í neinum niðurstöðum. Rannsóknin er gerð með leyfi Vísindasiðanefndar og tilkynning um rannsóknina verður send til Persónuverndar.

Ef þú hefur spurningar um rétt þinn sem þátttakandi í vísindarannsókn eða vilt hætta þátttöku í rannsókninni getur þú snúið þér til Vísindasiðanefndar, Vegmúla 3, 108 Reykjavík. Sími: 551-7100, fax: 551-1444.

____

Staður og dags.

____

Undirskrift

Sérfræðingur og rannsakendur
Pálmi V. Jónsson, lyf- og öldrunarlæknir
Sími: 55439410
Netfang: palmivj@landspitali.is

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Sérfræðingur og rannsakendur
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Rannsakandi
Janus Guðlaugsson, M.Ed.-íþróttafræðingur
Sími: 8980786
Netfang: janus@khi.is

Appendix 4

Written consent from Multimodal Training Intervention: An Approach to Successful Aging:

Samþykki Vísindasiðanefndar

Kennaraháskóli Íslands, Íþróttafræðasetur,
Laugarvatni
Erlingur Jóhannsson, prófessor
Laugarvatni
840 Laugarvatn

VÍSINDASIÐANEFND

Vegmúla 3, 108 Reykjavík,

Sími: 551 7100, Bréfsími: 551 1444

netfang: visindasidanefnd@vsn.stjr.is

Reykjavík 1. apríl 2008
Tilvísun: VSNb2008030014/03-1 Ný almenn rannsóknar umsókn/BH/--

Varðar: 08-071-S1 Líkams- og heilsurækt aldraðra-. Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða.

Vísindasiðanefnd þakkar svarbréf þitt, dags. 31.03.2008 vegna áðursendra athugasemda við ofangreinda rannsóknaráætlun sbr. bréf nefndarinnar dags. 18.03.2008. Í bréfinu koma fram svör og skýringar til samræmis við athugasemdir Vísindasiðanefndar og því fylgdu ný og endurbætt upplýsinga- og samþykkisbréf til þátttakenda rannsóknarinnar.

Fjallað hefur verið um svarbréf þitt og önnur innsend gögn og eru þau talin fullnægjandi.

Rannsóknaráætlunin er endanlega samþykkt af Vísindasiðanefnd.

Vísindasiðanefnd bendir rannsakendum vinsamlegast á að birta VSN tilvísunarnúmer rannsóknarinnar þar sem vitnað er í leyfi nefndarinnar í birtum greinum um rannsóknina. Jafnframt fer Vísindasiðanefnd fram á að fá send afrit af, eða tilvísun í, birtar greinar um rannsóknina. Rannsakendur eru minntir á að tilkynna rannsóknarlok til nefndarinnar.

Með kveðju,
f.h. Vísindasiðanefndar,

Laura Sch. Thorsteinsson

Laura Sch. Thorsteinsson, starfandi formaður

Appendix 5

Written consent from Multimodal Training Intervention: An Approach to Successful Aging:

Spurningalisti sem tengist upplýsingum frá þátttakendum um næringu

Raðnúmer: ____________

Líkams- og heilsurækt eldri aldurshópa
Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða

Dagbókin

- HÖFUÐBORGARHÓPUR -
1. – 8. vika

Nafn: ______________________________ Kennitala: ____________________

Sími ______________ GSM: ______________

- ***Kæri þátttakandi***

Útskýringar vegna skráninga á þjálfun í dagbók

- Daglega skal skrá eigin þjálfun eins og kostur er samkvæmt sýnishorni á bls. 4 og 5. Hægt er að skrá jafnt og þétt yfir daginn eða skrá allt í lok dagsins. Sýnishorn af skráningum má sjá á næstu opnu. Skráningarblaðið fyrir þig er á bls. 6 og 7 og á næstu blaðsíðum.

Útskýringar vegna skráninga á næringu í dagbók

- Daglega skal skrá neyslu eftirtalinna matvæla í skömmtum. Hægt er að skrá jafnt og þétt yfir daginn eða skrá allt í lok dagsins.

Hvað er 1 skammtur mikið?	
Lýsi / D-vítamín =	Ef lýsi / D-vítamín er tekið þá er krossað í reitinn (x)
Ávextir =	Einn meðalstór ávöxtur eða 1/2 dl af þurrkuðum ávöxtum eða 1 dl af niðursneiddum ávöxtum
Grænmeti =	Eitt meðalstórt stykki (75-100g) eða 1 dl af soðnu grænmeti eða 2 dl af hráu grænmeti
Gróft korn =	Ein brauðsneið eða 1/2 brauðkolla eða 2 hrökkbrauðssneiðar/bruður eða 1 diskur af ósykruðu morgunkorni eða korngraut eða 1 dl af hýðisgrjónum eða heilhveitipasta
Mjólk =	Eitt mjólkurglas (1 glas = 2 dl) eða dós eða diskur af mjólkurmat eða 4 ostsneiðar (skornar með ostaskera) eða 1 dl af kotasælu
Vatn =	Eitt glas. Merkja skal fjölda glasa yfir daginn (1 glas = 2 dl)

Dæmi:
Jón byrjar daginn á því að fá sér lýsi og hafragraut með mjólk. Milli mála fær hann sér einn banana. Í hádeginu borðar hann gróft rúnnstykki með osti og 1 tómat og 1 dós af jógúrt. Síðdegis fær hann sér grófkorna hrökkbrauð (2 sneiðar) með kaffu. Í kvöldmatinn er soðið grænmeti sem þekur um það bil 1/3 af diskinum. Jón fékk sér vatnsglas með öllum máltíðum auk 1/2 lítra af vatni eftir gönguæfinguna.

Hvernig skráir maður þetta inn?

Næring	*Næring*
Ef já (x)	*Lýsi / D-vítamín (X)*
Fjöldi skammta	*Ávextir* ___1___
Fjöldi skammta	*Grænmeti* ___3___
Fjöldi skammta	*Gróft korn* ___4___
Fjöldi skammta	*Mjólk* ___2___ *skammtar*
Fjöldi skammta	*Vatn* ___7___ *glös*

1

Sýnishorn á dagbók

[illegible]	Mánudagur ___ júní	Þriðjudagur ___ júní	Miðvikudagur ___ júní	Fimmtudagur ___ júní	Föstudagur ___ júní	Laugardagur ___ júní	Sunnudagur ___ júní	Upplýsingar í vikulok [illegible] 30 mín á dag 210 mín á viku
Bundin æfing í [illegible] • Ganga • Styrkur	World Class - Laugar Laugardalur Ganga Kl. 09:00 (hH-1) Kl. 10:00 (hH-2) Göngutími = 20 mín (X) Ég tók þátt	World Class - Laugar [illegible] - Styrkur Kl. 08.30-11.30 Sjá æfingu á staðnum (X) Ég tók þátt Göngutími = 20 mín (X) Ég tók þátt	Sjálfstæð ganga Kl. 10 - 11 Göngutími = 30 mín (X) Ég tók þátt	World Class - Laugar Laugardalur Ganga Kl. 09:00 (hH-1) Kl. 10:00 (hH-2) Göngutími = 20 mín (X) Ég tók þátt	World Class - Laugar [illegible] - Styrkur Kl. 08.30-11.30 Sjá æfingu á staðnum (X) Ég tók þátt Göngutími = 30 mín (X) Ég tók þátt	Sjálfstæð ganga Kl. ___ Göngutími = 30 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. 17 - 18 Göngutími = 30 mín (X) Ég tók þátt	[illegible] Samtals [illegible] • Ganga 180 mín • Styrkur 1x ( ) • Styrkur 2x (x) [illegible] 60
Sjálfstæð hreyfing	Hvað: ___ Hve lengi: ___ mín	Hvað: ___ Hve lengi: ___ mín	Hvað: [illegible] Hve lengi: 30 mín	Hvað: ___ Hve lengi: ___ mín	Hvað: ___ Hve lengi: ___ mín	Hvað: ___ Hve lengi: ___ mín	Hvað: ___ Hve lengi: ___ mín	Samtals: Hvað: [illegible] Hve lengi: 30 mín
Hvað gert?	Hvað: ___ Hve lengi: ___ mín	Hvað: ___ Hve lengi: ___ mín	Hvað: ___ Hve lengi: ___ mín	Hvað: Ganga Hve lengi: 30 mín	Hvað: ___ Hve lengi: ___ mín	Hvað: ___ Hve lengi: ___ mín	Hvað: ___ Hve lengi: ___ mín	Samtals: Hvað: Ganga Hve lengi: 30 mín
Hve lengi?	Hvað: Leikfimi Hve lengi: 40 mín	Hvað: ___ Hve lengi: ___ mín	Hvað: ___ Hve lengi: ___ mín	Hvað: ___ Hve lengi: ___ mín	Hvað: Dans Hve lengi: 60 mín	Hvað: ___ Hve lengi: ___ mín	Hvað: ___ Hve lengi: ___ mín	Samtals: Hvað: Leikfimi + Dans Hve lengi: 40 + 60 mín

3

Sýnishorn á dagbók, frh.

[illegible]	Mánudagur ___ júní	Þriðjudagur ___ júní	Miðvikudagur ___ júní	Fimmtudagur ___ júní	Föstudagur ___ júní	Laugardagur ___ júní	Sunnudagur ___ júní	Upplýsingar í vikulok / vikudeg
Næring [illegible] Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta	Næring Lýsi / D-vítamín (X) Ávextir 1 Grænmeti 4 Gróft korn 2 Mjólk 1 Vatn 7 glös	Næring Lýsi / D-vítamín (X) Ávextir 1 Grænmeti 4 Gróft korn 2 Mjólk 1 Vatn 2 glös	Næring Lýsi / D-vítamín (X) Ávextir 2 Grænmeti 1 Gróft korn 1 Mjólk 2 Vatn 7 glös	Næring Lýsi / D-vítamín ( ) Ávextir 4 Grænmeti 2 Gróft korn 1 Mjólk 2 Vatn 1 glös	Næring Lýsi / D-vítamín (X) Ávextir 3 Grænmeti 2 Gróft korn 2 Mjólk 2 Vatn 7 glös	Næring Lýsi / D-vítamín (X) Ávextir 1 Grænmeti 1 Gróft korn 2 Mjólk 1 Vatn 3 glös	Næring Lýsi / D-vítamín ( ) Ávextir 1 Grænmeti 2 Gróft korn 1 Mjólk 2 Vatn 2 glös	
Máltíðir	( ) Góð (x) Sæmileg ( ) Slæm	( ) Góð (x) Sæmileg ( ) Slæm	(x) Góð ( ) Sæmileg ( ) Slæm	( ) Góð (x) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg (x) Slæm	( ) Góð (x) Sæmileg ( ) Slæm	(x) Góð ( ) Sæmileg ( ) Slæm	
Líðan	Í dag hefur mér liðið: ( ) Mjög vel (X) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: (X) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel (X) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: (X) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel (X) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: (X) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: (X) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í vikunni [illegible]: ( ) Mjög vel (X) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa
Að sofna	Sofnaði í gær kl. 23:00	Sofnaði í gær kl. [illegible]	Sofnaði í gær kl. 22:00	Sofnaði í gær kl. 22:00	Sofnaði í gær kl. 22:00	Sofnaði í gær kl. 22:00	Sofnaði í gær kl. 21:00	
Vaknaði	Vaknaði kl. [illegible]	Vaknaði kl. [illegible]	Vaknaði kl. [illegible]	Vaknaði kl. [illegible]	Vaknaði kl. [illegible]	Vaknaði kl. [illegible]	Vaknaði kl. [illegible]	
Svefntími	Svefntími 9 klst	Svefntími 10 klst	Svefntími 9 klst	Svefntími 8,5 klst	Svefntími 9 klst	Svefntími 8,5 klst	Svefntími 8 klst	

4

Dagbók vikunnar – 1. þjálfunarvika
Vikan 2. – 8. júní 2008

Helstu atriði	Mánudagur 2. júní	Þriðjudagur 3. júní	Miðvikudagur 4. júní	Fimmtudagur 5. júní	Föstudagur 6. júní	Laugardagur 7. júní	Sunnudagur 8. júní	Uppgjör í vikulok Lágmarks göngumarkmið 20 mín á dag 140 mín á viku
Bundin æfing (Líkams- og heilsurækt) • Ganga • Styrkur	World Class - Laugar Laugardalur Ganga Kl. 09:00 (ÞH-1) Kl. 10:00 (ÞH-2) Göngutími = 20 mín ( ) Ég tók þátt	World Class - Laugar Tækjasalur - Styrkur Kl. 08.30–11.30 Sjá æfingu á staðnum ( ) Ég tók þátt Göngutími = 20 mín ( ) Ég tók þátt	Sjálfvalin ganga Kl. ____ Göngutími = 20 mín ( ) Ég tók þátt	World Class - Laugar Laugardalur Ganga Kl. 09:00 (ÞH-1) Kl. 10:00 (ÞH-2) Göngutími = 20 mín ( ) Ég tók þátt	World Class - Laugar Tækjasalur - Styrkur Kl. 08.30–11.30 Sjá æfingu á staðnum ( ) Ég tók þátt Göngutími = 20 mín ( ) Ég tók þátt	Sjálfvalin ganga Kl. ____ Göngutími = 20 mín ( ) Ég tók þátt	Sjálfvalin ganga Kl. ____ Göngutími = 20 mín ( ) Ég tók þátt	Líkams- og heilsurækt Samtals tími vikunnar • Ganga ____ mín • Styrkur 1 x ( ) • Styrkur 2 x ( ) Hvíldarpúls ____
Sjálfvalin hreyfing	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Samantekt Hvað: ____ Hve lengi: ____ mín
Hvað gert?	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Samantekt Hvað: ____ Hve lengi: ____ mín
Hve lengi?	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Hvað: ____ Hve lengi: ____ mín	Samantekt Hvað: ____ Hve lengi: ____ mín

5

Helstu atriði	Mánudagur 2. júní	Þriðjudagur 3. júní	Miðvikudagur 4. júní	Fimmtudagur 5. júní	Föstudagur 6. júní	Laugardagur 7. júní	Sunnudagur 8. júní	Uppgjör í vikulok
Næring Þ.e. (x) Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	
Matarlyst	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	
Líðan	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í vikulok líður mér: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa
Að sofna	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	
Vaknaði	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	
Svefntími	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	

6

Dagbók vikunnar – 2. þjálfunarvika
Vikan 9. – 15. júní 2008

Helstu atriði	Mánudagur 9. júní	Þriðjudagur 10. júní	Miðvikudagur 11. júní	Fimmtudagur 12. júní	Föstudagur 13. júní	Laugardagur 14. júní	Sunnudagur 15. júní	Uppgjör í vikulok Lágmarks göngumarkmið 24 mín á dag 168 mín á viku
Bundnar æfingar [illegible] • Ganga • Styrkur	World Class - Laugar Laugardalur Ganga Kl. 09:00 (DH-1) Kl. 10:00 (DH-2) Göngutími = 24 mín ( ) Ég tók þátt	World Class - Laugar Tækjasalur - Styrkur Kl. 08:30–11:30 Sjá æfingu á [illegible] ( ) Ég tók þátt Göngutími = 24 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ______ Göngutími = 24 mín ( ) Ég tók þátt	World Class - Laugar Laugardalur Ganga Kl. 09:00 (DH-1) Kl. 10:00 (DH-2) Göngutími = 24 mín ( ) Ég tók þátt	World Class - Laugar Tækjasalur - Styrkur Kl. 08:30–11:30 Sjá æfingu á [illegible] ( ) Ég tók þátt Göngutími = 24 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ______ Göngutími = 24 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ______ Göngutími = 24 mín ( ) Ég tók þátt	[illegible] Samtals fyrir vikuna: • Ganga ____ mín • Styrkur 1 x ( ) • Styrkur 2 x ( ) [illegible] ____
Sjálfstæð hreyfing	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Samantekt Hvað: ______ Hve lengi: ____ mín
Hvað gerir?	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Samantekt Hvað: ______ Hve lengi: ____ mín
Hve lengi?	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Hvað: ______ Hve lengi: ____ mín	Samantekt Hvað: ______ Hve lengi: ____ mín

7

Helstu atriði	Mánudagur 9. júní	Þriðjudagur 10. júní	Miðvikudagur 11. júní	Fimmtudagur 12. júní	Föstudagur 13. júní	Laugardagur 14. júní	Sunnudagur 15. júní	Uppgjör í vikulok
Næring [illegible] Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	
Matarlyst	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	
Líðan	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í vikulok líður mér: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa
Að sofna	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	
Vaknaði	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	
Svefntími	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	

8

Dagbók vikunnar – 3. þjálfunarvika
Vikan 16. – 22. júní 2008

Helstu atriði	Mánudagur 16. júní	Þriðjudagur 17. júní	Miðvikudagur 18. júní	Fimmtudagur 19. júní	Föstudagur 20. júní	Laugardagur 21. júní	Sunnudagur 22. júní	Uppgjör í vikulok Lágmarks göngumarkmið 20 mín á dag 140 mín á viku
Bundin æfing [illegible] • Ganga • Styrkur	World Class - Laugar Laugardalur Ganga Kl. 09:00 (DH-1) Kl. 10:00 (DH-2) Göngutími + 20 mín ( ) Ég tók þátt	World Class - Laugar Tækjasalur - Styrkur Kl. 08:30-11:30 Þú æfðir á staðnum ( ) Ég tók þátt Göngutími + 20 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ____ Göngutími + 20 mín ( ) Ég tók þátt	World Class - Laugar Laugardalur Ganga Kl. 09:00 (DH-1) Kl. 10:00 (DH-2) Göngutími + 20 mín ( ) Ég tók þátt	World Class - Laugar Tækjasalur - Styrkur Kl. 08:30-11:30 Þú æfðir á staðnum ( ) Ég tók þátt Göngutími + 20 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ____ Göngutími + 20 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ____ Göngutími + 20 mín ( ) Ég tók þátt	Líkams- og heilsurækt Samtals [illegible] • Ganga ____ mín • Styrkur 1 x ( ) • Styrkur 2 x ( ) [illegible] ____
Sjálfstæð hreyfing	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Samantekt Hvað ____ Hve lengi ____ mín
Hvað gerir?	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Samantekt Hvað ____ Hve lengi ____ mín
Hve lengi?	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Samantekt Hvað ____ Hve lengi ____ mín

9

Helstu atriði	Mánudagur 16. júní	Þriðjudagur 17. júní	Miðvikudagur 18. júní	Fimmtudagur 19. júní	Föstudagur 20. júní	Laugardagur 21. júní	Sunnudagur 22. júní	Uppgjör í vikulok
Næring [illegible] Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta	Næring Lýsis-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsis-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsis-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsis-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsis-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsis-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsis-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	
Máltíðir	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	
Líðan	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í vikunni leið mér: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa
Að sofna	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	
Vaknað	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	
Svefntími	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	

10

Dagbók vikunnar – 4. þjálfunarvika
Vikan 23. júní – 29. júní 2008

Heilsu athöfn	Mánudagur 23. júní	Þriðjudagur 24. júní	Miðvikudagur 25. júní	Fimmtudagur 26. júní	Föstudagur 27. júní	Laugardagur 28. júní	Sunnudagur 29. júní	Uppgjör í vikulok Lágmarks göngumarkmið 33 mín á dag 180 mín á viku
Bundin æfing í starfs- og heilsu-reit • Ganga • Styrkur	World Class - Laugar Laugardalur Ganga Kl. 09:00 (DH-1) Kl. 10:00 (DH-2) Göngutími = 26 mín ( ) Ég tók þátt	World Class - Laugar Tækjasalur - Styrkur Kl. 08:30-11:30 Sjá æfingu á staðnum ( ) Ég tók þátt Göngutími = 26 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ____ Göngutími = 26 mín ( ) Ég tók þátt	World Class - Laugar Laugardalur Ganga Kl. 09:00 (DH-1) Kl. 10:00 (DH-2) Göngutími = 26 mín ( ) Ég tók þátt	World Class - Laugar Tækjasalur - Styrkur Kl. 08:30-11:30 Sjá æfingu á staðnum ( ) Ég tók þátt Göngutími = 26 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ____ Göngutími = 26 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ____ Göngutími = 26 mín ( ) Ég tók þátt	Líkams- og heilsurækt Samtals fyrir vikuna: • Ganga ____ mín • Styrkur 1 × ( ) • Styrkur 2 × ( ) Hvíldarpúls ____
Sjálfstæð hreyfing	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Samantekt Hvað: ____ Hve lengi: ____ mín
Hvað gert?	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Samantekt Hvað: ____ Hve lengi: ____ mín
Hve lengi?	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Samantekt Hvað: ____ Hve lengi: ____ mín

11

Heilsu athöfn	Mánudagur 23. júní	Þriðjudagur 24. júní	Miðvikudagur 25. júní	Fimmtudagur 26. júní	Föstudagur 27. júní	Laugardagur 28. júní	Sunnudagur 29. júní	Uppgjör í vikulok
Næring [illegible] Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta	Næring Lýsi/vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	
Matarlyst	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	
Líðan	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í vikunni leið mér: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa
Að sofna	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	
Vaknað	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	
Svefntími	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	

12

Dagbók vikunnar – 5. þjálfunarvika
Vikan 30. júní – 6. júlí 2008

Helstu atriði	Mánudagur 30. júní	Þriðjudagur 1. júlí	Miðvikudagur 2. júlí	Fimmtudagur 3. júlí	Föstudagur 4. júlí	Laugardagur 5. júlí	Sunnudagur 6. júlí	Uppgjör í vikulok Lágmarks göngumarkmið 20 mín á dag 140 mín á viku
Bundin æfing (líkams- og heilsurækt) • Ganga • Styrkur	World Class - Laugar Laugardalur Ganga Kl. 08:00 (hH-1) Kl. 10:00 (hH-2) Göngutími = 20 mín ( ) Ég tók þátt	World Class - Laugar Tækjasalur - Styrkur Kl. 08.30–11.30 Sjá æfingu á staðnum ( ) Ég tók þátt Göngutími = 20 mín ( ) Ég tók þátt	Sjálfvalin ganga Kl. ____ Göngutími = 20 mín ( ) Ég tók þátt	World Class - Laugar Laugardalur Ganga Kl. 08:00 (hH-1) Kl. 10:00 (hH-2) Göngutími = 20 mín ( ) Ég tók þátt	World Class - Laugar Tækjasalur - Styrkur Kl. 08.30–11.30 Sjá æfingu á staðnum ( ) Ég tók þátt Göngutími = 20 mín ( ) Ég tók þátt	Sjálfvalin ganga Kl. ____ Göngutími = 20 mín ( ) Ég tók þátt	Sjálfvalin ganga Kl. ____ Göngutími = 20 mín ( ) Ég tók þátt	Líkams- og heilsurækt Samtals tími vikunnar • Ganga: ____ mín • Styrkur 1 x ( ) • Styrkur 2 x ( ) Heildarsþóls ____
Sjálfvalin hreyfing	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Samantekt: Hvað ____ Hve lengi ____ mín
Hvað gert?	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Samantekt: Hvað ____ Hve lengi ____ mín
Hve lengi?	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Samantekt: Hvað ____ Hve lengi ____ mín

13

Helstu atriði	Mánudagur 30. júní	Þriðjudagur 1. júlí	Miðvikudagur 2. júlí	Fimmtudagur 3. júlí	Föstudagur 4. júlí	Laugardagur 5. júlí	Sunnudagur 6. júlí	Uppgjör í vikulok
Næring Ég át: Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	
Matarlyst	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	
Líðan	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í vikulok líður mér: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa
Að sofna	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	
Vaknaði	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	
Svefntími	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	

14

Dagbók vikunnar – 6. þjálfunarvika
Vikan 7. – 13. júlí 2008

Helstu atriði	Mánudagur 7. júlí	Þriðjudagur 8. júlí	Miðvikudagur 9. júlí	Fimmtudagur 10. júlí	Föstudagur 11. júlí	Laugardagur 12. júlí	Sunnudagur 13. júlí	Uppgjör í vikulok Lágmarks göngumarkmið 32 mín á dag 224 mín á viku
Bundin æfing [illegible] • Ganga • Styrkur	World Class - Laugar Laugardalur Ganga Kl. 08:00 (644-1) Kl. 12:00 (644-2) Göngutími = 32 mín ( ) Ég tók þátt	World Class - Laugar Tækjasalur - Styrkur Kl. 08:30–11:30 Sjá æfingu á staðnum ( ) Ég tók þátt Göngutími = 32 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ______ Göngutími = 32 mín ( ) Ég tók þátt	World Class - Laugar Laugardalur Ganga Kl. 08:00 (644-1) Kl. 12:00 (644-2) Göngutími = 32 mín ( ) Ég tók þátt	World Class - Laugar Tækjasalur - Styrkur Kl. 08:30–11:30 Sjá æfingu á staðnum ( ) Ég tók þátt Göngutími = 32 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ______ Göngutími = 32 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ______ Göngutími = 32 mín ( ) Ég tók þátt	Líkams- og heilsurækt Samtals tími vikunnar • Ganga: ______ mín • Styrkur 1 x ( ) • Styrkur 2 x ( ) Hvíldarpúls: ______
Sjálfstæð hreyfing	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Samantekt Hvað: ______ Hve lengi: ______ mín
Hvað gerir?	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Samantekt Hvað: ______ Hve lengi: ______ mín
Hve lengi?	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Hvað: ______ Hve lengi: ______ mín	Samantekt Hvað: ______ Hve lengi: ______ mín

13

Helstu atriði	Mánudagur 7. júlí	Þriðjudagur 8. júlí	Miðvikudagur 9. júlí	Fimmtudagur 10. júlí	Föstudagur 11. júlí	Laugardagur 12. júlí	Sunnudagur 13. júlí	Uppgjör í vikulok
Næring [illegible] (x) Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta	Næring Lýsi/D-vítamín ( ) Ávextir ______ Grænmeti ______ Gróft korn ______ Mjólk ______ Vatn ______ glös	Næring Lýsi/D-vítamín ( ) Ávextir ______ Grænmeti ______ Gróft korn ______ Mjólk ______ Vatn ______ glös	Næring Lýsi/D-vítamín ( ) Ávextir ______ Grænmeti ______ Gróft korn ______ Mjólk ______ Vatn ______ glös	Næring Lýsi/D-vítamín ( ) Ávextir ______ Grænmeti ______ Gróft korn ______ Mjólk ______ Vatn ______ glös	Næring Lýsi/D-vítamín ( ) Ávextir ______ Grænmeti ______ Gróft korn ______ Mjólk ______ Vatn ______ glös	Næring Lýsi/D-vítamín ( ) Ávextir ______ Grænmeti ______ Gróft korn ______ Mjólk ______ Vatn ______ glös	Næring Lýsi/D-vítamín ( ) Ávextir ______ Grænmeti ______ Gróft korn ______ Mjólk ______ Vatn ______ glös	
Matarlyst:	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	
Líðan	Í dag hefur mér liðið ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í vikulok líður mér ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa
Að sofna	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	
Vaknaði	Vaknaði kl. ______	Vaknaði kl. ______	Vaknaði kl. ______	Vaknaði kl. ______	Vaknaði kl. ______	Vaknaði kl. ______	Vaknaði kl. ______	
Svefntími	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	

14

Dagbók vikunnar – 7. þjálfunarvika
Vikan 14. – 20. júlí 2008

Helstu atriði	Mánudagur 14. júlí	Þriðjudagur 15. júlí	Miðvikudagur 16. júlí	Fimmtudagur 17. júlí	Föstudagur 18. júlí	Laugardagur 19. júlí	Sunnudagur 20. júlí	Uppgjör í vikulok Lágmarks göngumarkmið 30 mín á dag 210 mín á viku
Bundin æfing (Þrek- og tækni-tæki) • Ganga • Styrkur	**World Class - Laugar** **Laugardalur** **Ganga** Kl. 09:00 (OH-1) Kl. 10:00 (OH-2) Göngutími = 30 mín ( ) Ég tók þátt	**World Class - Laugar** **Tækjasalur - Styrkur** **Kl. 09:30–11:30** Sjá æfingu á staðnum ( ) Ég tók þátt Göngutími = 30 mín ( ) Ég tók þátt	**Sjálfstæð ganga** Kl. ________ Göngutími = 30 mín ( ) Ég tók þátt	**World Class - Laugar** **Laugardalur** **Ganga** Kl. 09:00 (OH-1) Kl. 10:00 (OH-2) Göngutími = 30 mín ( ) Ég tók þátt	**World Class - Laugar** **Tækjasalur - Styrkur** **Kl. 09:30–11:30** Sjá æfingu á staðnum ( ) Ég tók þátt Göngutími = 30 mín ( ) Ég tók þátt	**Sjálfstæð ganga** Kl. ________ Göngutími = 30 mín ( ) Ég tók þátt	**Sjálfstæð ganga** Kl. ________ Göngutími = 30 mín ( ) Ég tók þátt	Þrek- og tæknitæki Samtals (fer) vikunnar: • Ganga ____ mín • Styrkur 1 x ( ) • Styrkur 2 x ( ) Heildargildi ____
Sjálfstæð hreyfing	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Samantekt Hvað ____ Hve lengi ____ mín
Hvað gert?	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Samantekt Hvað ____ Hve lengi ____ mín
Hve lengi?	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Hvað ____ Hve lengi ____ mín	Samantekt Hvað ____ Hve lengi ____ mín

17

Helstu atriði	Mánudagur 14. júlí	Þriðjudagur 15. júlí	Miðvikudagur 16. júlí	Fimmtudagur 17. júlí	Föstudagur 18. júlí	Laugardagur 19. júlí	Sunnudagur 20. júlí	Uppgjör í vikulok
Næring Lýsi (x) Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta	**Næring** Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	**Næring** Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	**Næring** Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	**Næring** Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	**Næring** Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	**Næring** Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	**Næring** Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	
Matarlyst	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	
Líðan	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í vikulok líður mér: ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa
Að sofna	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	
Vaknaði	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	
Svefntími	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	

18

Dagbók vikunnar – 8. þjálfunarvika
Vikan 21. – 27. júlí 2008

Helstu atriði	Mánudagur 21. júlí	Þriðjudagur 22. júlí	Miðvikudagur 23. júlí	Fimmtudagur 24. júlí	Föstudagur 25. júlí	Laugardagur 26. júlí	Sunnudagur 27. júlí	Uppgjör í vikulok Lágmarks göngumarkmið 32 mín á dag 224 mín á viku
Bundnar æfingar í þrek- og hreyfi-salnum • Ganga • Styrkur	World Class - Laugar Laugardalur Ganga Kl. 09:00 (ÞH-1) Kl. 10:00 (ÞH-2) Göngutími = 32 mín ( ) Ég tók þátt	World Class - Laugar Tækjasalur - Styrkur Kl. 08.00-11.00 Sjá æfingu á staðnum ( ) Ég tók þátt Göngutími = 32 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ______ Göngutími = 32 mín ( ) Ég tók þátt	World Class - Laugar Laugardalur Ganga Kl. 09:00 (ÞH-1) Kl. 10:00 (ÞH-2) Göngutími = 32 mín ( ) Ég tók þátt	World Class - Laugar Tækjasalur - Styrkur Kl. 08.00-11.00 Sjá æfingu á staðnum ( ) Ég tók þátt Göngutími = 32 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ______ Göngutími = 32 mín ( ) Ég tók þátt	Sjálfstæð ganga Kl. ______ Göngutími = 32 mín ( ) Ég tók þátt	Lausn- og hreyfiæfingar Samtals tími vikunnar • Ganga ____ mín • Styrkur 1 = ( ) • Styrkur 2 = ( ) Hvíldarpúls ____
Sjálfstæð hreyfing	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Samantekt Hvað: ____ Hve lengi ____ mín
Hvað gert?	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Samantekt Hvað: ____ Hve lengi ____ mín
Hve lengi?	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Hvað: ____ Hve lengi ____ mín	Samantekt Hvað: ____ Hve lengi ____ mín

19

Helstu atriði	Mánudagur 21. júlí	Þriðjudagur 22. júlí	Miðvikudagur 23. júlí	Fimmtudagur 24. júlí	Föstudagur 25. júlí	Laugardagur 26. júlí	Sunnudagur 27. júlí	Uppgjör í vikulok
Næring Ég át (x) Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta Fjöldi skammta	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	Næring Lýsi/D-vítamín ( ) Ávextir ____ Grænmeti ____ Gróft korn ____ Mjólk ____ Vatn ____ glös	
Matarlyst	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	( ) Góð ( ) Sæmileg ( ) Slæm	
Líðan	Í dag hefur mér liðið ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í dag hefur mér liðið ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa	Í vikulok líður mér ( ) Mjög vel ( ) Vel ( ) Sæmilega ( ) Illa ( ) Mjög illa
Að sofna	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	Sofnaði í gær kl. ____	
Vaknaði	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	Vaknaði kl. ____	
Svefntími	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	Svefntími ____ klst	

20

Appendix 6

Written consent from Multimodal Training Intervention: An Approach to Successful Aging:

Æfingaáætlun I og II í líkams- og heilsurækt (fyrir 26 vikur)

Líkams- og heilsurækt eldri aldurshópa
Íhlutunarrannsókn til bættrar heilsu og betri vellíðunar

Æfingaáætlun I

Styrktarþjálfun

____
Nafn

Mánudagur	Þriðjudagur	Miðvikudagur	Fimmtudagur	Föstudagur	Laugardagur	Sunnudagur
Gönguþjálfun	Styrktarþjálfun	Sjálfstæð gönguþjálfun	Gönguþjálfun	Styrktarþjálfun	Sjálfstæð gönguþjálfun	Sjálfstæð gönguþjálfun

Upphitun: 10-12 mín. : Hitað upp á göngu- og hlaupabrettum, hjóli eða öðrum þoltækjum
Aðalþáttur: 20-60 mín.: **Styrktarþjálfun** í tækjasal
Niðurlag: 10 mín.: Gengið rólega, liðkun, teygt á helstu vöðvahópum, slökun

Karvonen-formúlan: 220 – aldur – hvíldarpúls = tala x álag (0,5) + hvíldarpúls = Þolþjálfunarpúls

220 – ______= ________ – ________= ________ X 0_____ + __________ = __________________

	Þol- og upphitunartæki														
	Sýnishorn		Dagsetningar												
Þjálfunarvikur			1	1	2	2	3	3	4	4	5	5	6	6	
Hlaupaband[1] / **Skíðavél**[2] / Hjól / **Annað**	Hb[1] 25.3	Skí[2] 26.3													
Upphitun (10-15 mín) (mín)	10	12													
Æfingaáætlun á tæki (Program)	M	M													
Álag – Hraði (km/klst) – (Speed)	4.0	4.5													
Ákefð – Þjálfunarpúls minn er	110	112													
Endurheimt - Þol (mín)	10	15													

220 – ______= ________ – ________= ________ X 0_____ + __________ = __________________

	Þol- og upphitunartæki														
	Sýnishorn		Dagsetningar												
Þjálfunarvikur	7	7	8	8	9	9	10	10	11	11	12	12	13	13	
Hlaupaband[1] / **Skíðavél**[2] / Hjól / **Annað**															
Upphitun (10-15 mín) (mín)															
Æfingaáætlun á tæki (program)															
Álag – Hraði – Speed (km/klst)															
Ákefð – Þjálfunarpúls minn er															
Endurheimt - Þol (mín)															

Styrktarþjálfun

- HRAÐBRAUT -

Vikur	Nr			1	1	2	2	3	3	4	4	5	5	6	6	7
Dagsetning																
Æfingar	Nr	RM	Endurt.	1x10	1x10	2x10	2x10	2x12	2x12	2x12	2x12	2x12	2x12	2x14	2x14	2x14
Kviðvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Tvíhöfði 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Þríhöfði 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Fótarétta (læri framanvert) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Kviðvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Bakvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Axlapressa 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Brjóstvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Fótbeygja (læri aftanvert) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Hnébeygja og hnérétta 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Bakvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Fótapressa			Þyngd													
Kviðvöðvar (Legið, olnbogar í gólfi)			Líkams-þyngd													
Bakvöðvar (Legið, fætur beygðar - mjaðmalyfta			Líkams-þyngd													

Fótrétta (stök – hægri/vinstri) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Fótbeygja (stök – hægri/vinstri) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													

Undirbúningur
1 x 10: 1 hringur – Lyftið 10 sinnum í hvert skipti – Hvílið (virk hvíld – teygja á vöðvahóp) – Næsta æfingatæki
2 x 12: 2 hringir – Lyftið 12 sinnum í hvert skipti – Hvílið (virk hvíld – teygja á vöðvahóp) – Næsta æfingatæki

Uppbygging fyrir vöðvaþol
2x12-18: 2 hringir – Lyftið 12-18 sinnum í hvert skipti – síðustu 2-3 skiptin eru nokkuð erfið

Styrktarþjálfun

- HRAÐBRAUT -

Vikur	Nr			7	8	8	9	9	10	10	11	11	12	12	13	13
Dagsetning																
Æfingar	Nr	RM	Endurt.	2x14	2x14	2x14	Hvíld	Hvíld	2x16	2x16	2x16	2x16	2x18	2x18	2x18	2x18
Kviðvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Tvíhöfði 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Þríhöfði 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Fótarétta (læri framanvert) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Kviðvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Bakvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Axlapressa 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Brjóstvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Fótbeygja (læri aftanvert) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Hnébeygja og hnérétta 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Bakvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Fótapressa			Þyngd													
Kviðvöðvar (Legið, olnbogar í gólfi)			Líkams-þyngd													
Bakvöðvar (Legið, fætur beygðar - mjaðmalyfta			Líkams-þyngd													
Fótrétta (stök – hægri/vinstri) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Fótbeygja (stök – hægri/vinstri) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													

Undirbúningur
1 x 12: 1 hringur – Lyftið 12 sinnum í hvert skipti – Hvílið (virk hvíld – teygja á vöðvahóp) – Næsta æfingatæki
2 x 12: 2 hringir – Lyftið 12 sinnum í hvert skipti – Hvílið (virk hvíld – teygja á vöðvahóp) – Næsta æfingatæki

Uppbygging fyrir vöðvaþol
2x15-20: 2 hringir – Lyftið 15-20 sinnum í hvert skipti – síðustu 2-3 skiptin eru nokkuð erfið

Líkams- og heilsurækt eldri aldurshópa
Íhlutunarrannsókn til bættrar heilsu og betri vellíðunar

Æfingaáætlun II

Styrktarþjálfun

____

Nafn

Mánudagur	Þriðjudagur	Miðvikudagur	Fimmtudagur	Föstudagur	Laugardagur	Sunnudagur
Gönguþjálfun	Styrktarþjálfun	Sjálfstæð gönguþjálfun	Gönguþjálfun	Styrktarþjálfun	Sjálfstæð gönguþjálfun	Sjálfstæð gönguþjálfun

Upphitun: 10-12 mín. : Hitað upp á göngu- og hlaupabrettum, hjóli eða öðrum þoltækjum
Aðalþáttur: 20-60 mín.: **Styrktarþjálfun** í tækjasal
Niðurlag: 10 mín.: Gengið rólega, liðkun, teygt á helstu vöðvahópum, slökun

Karvonen-formúlan: 220 – aldur – hvíldarpúls = tala x álag (0,5) + hvíldarpúls = Þolþjálfunarpúls

220 – _______ = ________ – ________ = ________ X 0,_____ + ___________ = ___________________

	Þol- og upphitunartæki														
	Sýnishorn		**Dagsetningar**												
Þjálfunarvikur			14	14	15	15	16	16	17	17	18	18	19	19	20
Hlaupaband[1] / Skíðavél[2] / Hjól / Annað	Hb[1] 25.3	Skí[2] 26.3													
Upphitun (10-15 mín) (mín)	10	12													
Æfingaáætlun á tæki (*Program*)	M	M													
Álag – Hraði – (*Speed*) (km/klst)	4,0	4,5													
Ákefð – Þjálfunarpúls minn er:	110	112													
Endurheimt - Þol (mín)	20	20													

220 – _______ = ________ – ________ = ________ X 0,_____ + ___________ = ___________________

	Þol- og upphitunartæki														
	Sýnishorn		**Dagsetningar**												
Þjálfunarvikur			20	21	21	22	22	23	23	24	24	25	25	26	26
Hlaupaband[1] / Skíðavél[2] / Hjól / Annað	Hb[1] 25.3	Skí[2] 26.3													
Upphitun (10-15 mín) (mín)	10	12													
Æfingaáætlun á tæki (program)	M	M													
Álag – Hraði – Speed (km/klst)	4,0	4,5													
Ákefð – Þjálfunarpúls minn er:	110	112													
Endurheimt - Þol (mín)	20	20													

Styrktarþjálfun

- HRAÐBRAUT -

Vikur	Nr			14	14	15	15	16	16	17	17	18	18	19	19	20
Dagsetning																
Æfingar	Nr	RM	Endurt.	2x10 RM	2x10 RM	2x10 RM	2x10 RM	2x8 RM	2x8 RM	2x8 RM	2x8 RM	Hvíld	Hvíld	2x10 RM	2x10 RM	2x10 RM
Kviðvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			þyngd													
Tvíhöfði 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			þyngd													
Þríhöfði 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			þyngd													
Fótarétta (læri framanvert) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			þyngd													
Kviðvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			þyngd													
Bakvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			þyngd													
Axlapressa 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			þyngd													
Brjóstvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			þyngd													
Fótbeygja (læri aftanvert) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			þyngd													
Hnébeygja og hnérétta 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			þyngd													
Bakvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			þyngd													
Fótapressa			þyngd													
Kviðvöðvar (Legið, olnbogar í gólfi)			Líkams-þyngd													
Bakvöðvar (Legið, fætur beygðar - mjaðmalyfta			Líkams-þyngd													

Fótrétta (stök – hægri/vinstri) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			þyngd													
Fótbeygja (stök – hægri/vinstri) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			þyngd													

Uppbygging fyrir vöðvamassa (6–10 skipti)

10RM*: Lyftið 10 sinnum, síðustu 2-3 skiptin eiga að vera erfið
Ef þið getið lyft þyngdinni í 10RM 11-12 sinnum þá vinsamlegast þyngið um 2,5 kg eða setjið einn takka inn.

*** 1RM:** Eitt RM er sú þyngd sem þú getur lyft einu sinni (ekki oftar) = 100% (skráð í gráu reitina)
Út frá 1RM (eða 100%) er síðan þyngdarálagið fundið, 50%, 60%, 70% o.s.frv. (skráð í hvítu reitina)

- 10RM eru því sú þyngd sem þú getur lyft 10 sinnum en ekki oftar, 8RM getur þú lyft 8 sinnum en ekki oftar o.s.frv.

Tækni: Lyfta þyngd af krafti á 1 sek. + færa þyngd (lóð) rólega til baka á 2 sek. (halda á móti)

Styrktarþjálfun
- HRAÐBRAUT -

Vikur	Nr			20	21	21	22	22	23	23	24	24	25	25	26	26
Dagsetning																
Æfingar	Nr	RM	Endurt.	2x10 RM	2x8 RM	2x8 RM	2x8 RM	2x8 RM	2x6 RM	2x6 RM	2x6 RM	2x6 RM	2x8 RM	2x8 RM	2x8 RM	2x8 RM
Kviðvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Tvíhöfði 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Þríhöfði 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Fótarétta (læri framanvert) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Kviðvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Bakvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Axlapressa 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Brjóstvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Fótbeygja (læri aftanvert) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Hnébeygja og hnérétta 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Bakvöðvar 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Fóatpressa			Þyngd													
Kviðvöðvar (Legið, olnbogar í gólfi)			Líkams-þyngd													
Bakvöðvar (Legið, fætur beygðar - mjaðmalyfta			Líkams-þyngd													

Fótrétta (stök – hægri/vinstri) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													
Fótbeygja (stök – hægri/vinstri) 1 2 3 4 5 6 7 8 9 10 11 12 O O O O O O O O O O O O			Þyngd													

Uppbygging fyrir vöðvamassa (6–10 skipti)
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*** 1RM:** Eitt RM er sú þyngd sem þú getur lyft einu sinni (ekki oftar) = 100% (skráð í gráu reitina)
Út frá 1RM (eða 100%) er síðan þyngdarálagið fundið, 50%, 60%, 70% o.s.frv. (skráð í hvítu reitina)
- 10RM eru því sú þyngd sem þú getur lyft 10 sinnum en ekki oftar, 8RM getur þú lyft 8 sinnum en ekki oftar o.s.frv.

Tækni: Lyfta þyngd af krafti á 1 sek. + færa þyngd (lóð) rólega til baka á 2 sek. (halda á móti)

Appendix 7

Written consent from Multimodal Training Intervention: An Approach to Successful Aging:

Heilsutengd lífsgæði: Spurningalisti

Rannsóknarnúmer: ___________

Heilsutengd lífsgæði

vegna rannsóknarinnar

Líkams- og heilsurækt aldraðra

Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða

Dags.: ____________

Nafn: ____

Kennitala: ____________________

- 1 -

HEILSUTENGD LÍFSGÆÐI

Við mat á árangri meðferðar skiptir mestu máli hvernig sjúklingum líður áður en hún hefst og hvort meðferðin hefur bætt það sem kalla má heilsutengd lífsgæði. Þau getur enginn metið betur en einstaklingurinn sjálfur. Svo að unnt sé að meta árangur meðferðarinnar er nauðsynlegt að hafa sambærileg gögn í sjúkraskrá. Því biðjum við þig að svara eftirfarandi spurningum núna með því að dekkja hringina með blýanti eða skrifa á línurnar, eftir því sem við á hverju sinni. Mikilvægt er að öllum spurningum sé svarað.

Aldur: _________ ára

0	O	O
1	O	O
2	O	O
3	O	O
4	O	O
5	O	O
6	O	O
7	O	O
8	O	O
9	O	O

Kyn:
- O karl
- O kona

1. Þegar á heildina er litið, finnst þér heilsa þín vera:

- O slæm
- O þokkaleg
- O góð
- O mjög góð
- O framúrskarandi

2. Varstu með verki síðastliðnar fjórar vikur og ef svo var, hve mikla verki?

- O mjög mikla
- O mikla
- O þó nokkra
- O litla
- O mjög litla
- O enga

3. Að hve miklu leyti hefur andleg eða líkamleg heilsa þín takmarkað félagslega umgengni þína við fjölskyldu, vini, nágranna eða aðra hópa, síðustu fjórar vikurnar?

- O mjög mikið
- O töluvert
- O þó nokkuð
- O svolítið
- O alls ekkert

4. Hversu hress og fjörmikil(l) hefur þú verið? (*síðastliðinn mánuð)*

- O alveg kraftlaus og uppgefin(n), öll orka búin
- O mjög þróttlítil(l) og dauf(ur) flestum stundum
- O yfirleitt frekar þróttlítil(l) og dauf(ur)
- O krafturinn í mér hefur sveiflast töluvert
- O oftast nokkuð hress og kraftmikil(l)
- O mjög hress - full(ur) orku

- 2 -

5. Hversu gleymin(n) hefur þú verið? *(síðastliðinn mánuð)*

- O mjög mikið
- O töluvert
- O þó nokkuð
- O svolítið
- O alls ekkert

6. Ég hef verið niðurdregin(n) og leið(ur) *(síðastliðinn mánuð)*

- O alltaf
- O yfirleitt
- O talsvert oft
- O stundum
- O einstöku sinnum
- O aldrei

7. Hefur þú verið svo hrygg(ur), kjarklítil(l), vonlaus, eða haft svo mörg vandamál á þinni könnu að þú hafir velt fyrir þér hvort allt væri tilgangslaust? *(síðastliðinn mánuð)*

- O afskaplega, ég hef verið að gefast upp
- O mjög
- O þó nokkuð
- O dálítið, nóg til að trufla mig
- O örlítið
- O alls ekki

8. Hefur þér fundist þú vera virk(ur) og þróttmikil(l) eða dauf(ur) og svifasein(n)? *(síðastliðinn mánuð)*

- O mjög dauf(ur) og svifasein(n) alla daga
- O yfirleitt dauf(ur) og svifasein(n)
- O frekar dauf(ur) og svifasein(n)
- O frekar virk(ur) og þróttmikil(l)
- O yfirleitt virk(ur) og þróttmikil(l)
- O mjög virk(ur) og þróttmikil(l) alla daga

9. Hefur þú verið afslöppuð/afslappaður og rólegur *eða* trekkt(ur), spennt(ur) og eins og fest(ur) upp á þráð? *(síðastliðinn mánuð)*

- O verið trekkt(ur), spennt(ur) og eins og fest(ur) upp á þráð allan mánuðinn
- O oftast nær verið trekkt(ur), spennnt(ur) og eins og fest(ur) upp á þráð
- O yfirleitt trekkt(ur) en hef stundum getað slappað af
- O yfirleitt afslöppuð/afslappaður en stundum dálítið trekkt(ur)
- O oftast nær verið afslöppuð/afslappaður og róleg(ur)
- O verið afslöppuð/afslappaður og róleg(ur) allan mánuðinn

- 3 -

10. Hefur þú verið kvíðin(n), áhyggjufull(ur) eða í geðshræringu? *(síðastliðinn mánuð)*

- ○ afskaplega - upp að því marki að vera veik(ur), eða nærri því
- ○ mjög svo
- ○ þó nokkuð
- ○ svolítið - nóg til að angra mig
- ○ dálítið
- ○ alls ekkert

11. Ég hef verið í tilfinningalegu jafnvægi og örugg(ur) með mig *(síðastliðinn mánuð)*

- ○ aldrei
- ○ einstöku sinnum
- ○ stundum
- ○ talsvert oft
- ○ yfirleitt
- ○ alltaf

12. Hvernig metur þú heilsufar þitt?

- ○ slæmt
- ○ sæmilegt
- ○ gott
- ○ mjög gott
- ○ gæti ekki verið betra

13. Kemur heilsa þín í veg fyrir að þú getir sinnt vinnu þinni, skóla eða heimilisstörfum?

- ○ já, og hefur gert það í meira en 3 mánuði
- ○ já, og hefur gert það í 3 mánuði eða styttri tíma
- ○ nei

14. Setur heilsan þér einhver takmörk núna við að vinna miðlungi erfið verk, t.d. færa til húsgögn, ryksoga eða bera matvælapoka inn eftir verslunarferð?

- ○ já, háir mér mikið
- ○ já, háir mér svolítið
- ○ nei, háir mér ekkert

15. Heilsa mín er mjög góð

- ○ örugglega rangt
- ○ að mestu rangt
- ○ veit ekki
- ○ að mestu rétt
- ○ örugglega rétt

- 4 -

16. Hve langan tíma síðustu fjórar vikur fannst þér þú vera full(ur) af lífsþrótti?

- O aldrei
- O lítinn hluta tímans
- O nokkurn hluta tímans
- O drjúgan hluta tímans
- O meiri hluta tímans
- O allan tímann

17. Hve langan tíma síðustu fjórar vikur hafðir þú næga orku?

- O aldrei
- O lítinn hluta tímans
- O nokkurn hluta tímans
- O drjúgan hluta tímans
- O meiri hluta tímans
- O allan tímann

18. Hve langan tíma síðustu fjórar vikur hefur þú verið niðurdregin(n) og leið(ur)?

- O allan tímann
- O meiri hluta tímans
- O drjúgan hluta tímans
- O nokkurn hluta tímans
- O lítinn hluta tímans
- O aldrei

19. Hve langan tíma síðustu fjórar vikur hefur þú verið vonlaus um framtíðina?

- O allan tímann
- O meiri hluta tímans
- O drjúgan hluta tímans
- O nokkurn hluta tímans
- O lítinn hluta tímans
- O aldrei

Merktu við það svar sem þér finnst eiga best við þig.

Hafðir þú óþægindi síðastliðna viku að meðtöldum deginum í dag vegna þess að þú:

20.	varst döpur (dapur)	alltaf O	oft O	stundum O	sjaldan O	aldrei O
21.	áttir erfitt með að sofna	alltaf O	oft O	stundum O	sjaldan O	aldrei O
22.	áttir erfitt með að einbeita þér	alltaf O	oft O	stundum O	sjaldan O	aldrei O

- 5 -

Dekktu þann hring sem lýsir því best hvernig viðkomandi fullyrðing á við um þig síðastliðna viku að meðtöldum deginum í dag.

23.	Líkamleg líðan mín er:	O slæm	O	O	O	O góð
24.	Mér finnst ég hafa stjórn á lífi mínu	O slæma	O	O	O	O góða
25.	Ég get látið enda ná saman	O illa	O	O	O	O vel
26.	Ég hef áhyggjur af fjárhag mínum	O miklar	O	O	O	O litlar
27.	Ég sef	O illa	O	O	O	O vel

Vinsamlega svaraðu spurningum 28 - 32 með því að merkja við eina tölu á hverjum kvarða. Leggðu mat þitt á skalann frá: 1= mjög óánægður til 10= hæst ánægður

28. Ertu ánægð(ur) með líf þitt eins og það er í dag?

O 1 – O 2 – O 3 – O 4 – O 5 – O 6 – O 7 – O 8 – O 9 – O 10

mjög óánægð(ur) ... hæst ánægð(ur)

29. Ertu ánægð(ur) með heilsu þína eins og hún er í dag?

O 1 – O 2 – O 3 – O 4 – O 5 – O 6 – O 7 – O 8 – O 9 – O 10

mjög óánægð(ur) ... hæst ánægð(ur)

30. Ertu ánægð(ur) með félagslega stöðu þína eins og hún er í dag?

O 1 – O 2 – O 3 – O 4 – O 5 – O 6 – O 7 – O 8 – O 9 – O 10

mjög óánægð(ur) ... hæst ánægð(ur)

31. Ertu ánægð(ur) með frístundir þínar eins og þær eru í dag?

O 1 – O 2 – O 3 – O 4 – O 5 – O 6 – O 7 – O 8 – O 9 – O 10

mjög óánægð(ur) ... hæst ánægð(ur)

32. Hvernig líður þér í dag?

O 1 – O 2 – O 3 – O 4 – O 5 – O 6 – O 7 – O 8 – O 9 – O 10

mjög illa ... mjög vel

Appendix 8

Written consent from Multimodal Training Intervention: An Approach to Successful Aging:

Mælingar: Matardagbók - Þriggja daga skráning

Raðnúmer: ___________

Matardagbók

- Þriggja daga skráning-

vegna rannsóknarinnar

Líkams- og heilsurækt aldraðra

Íhlutunarrannsókn til bættrar heilsu og betri lífsgæða

Höfuðborgarhópur

Ágæti þátttakandi!
Til að við fáum sem nákvæmasta mynd af mataræði þínu viljum við biðja þig að skrá niður á eins nákvæman hátt og þú getur allt sem þú borðar og drekkur í þrjá daga.

Þú getur ANNAÐ HVORT valið að skrá frá fimmtudegi til laugardags EÐA sunnudegi til og með þriðjudags, en mikilvægt er að þetta séu þrír **samfelldir** dagar. Æskilegt er að **skrá alla neyslu jafnóðum** því það kemur í veg fyrir eitthvað gleymist.

Gættu sérstaklega að þessu við skráninguna:

- Klukkan hvað var borðað.
- Lýstu tegund – til dæmis með því að skrifa merki framleiðanda eða tilgreina ef um heimagerða rétti var að ræða.
- Lýstu magni – hér má notast við grömm, stykki, rúmmál (dl, cl, l) eða heimiliseiningar, þ.e. glös, bolla, tsk, msk.
- Ekki gleyma að skrá ef þú færð þér oftar en einu sinni á diskinn.
- Skráðu alla drykki, líka vatn og áfenga drykki.
- Mundu eftir að skrá bætiefni s.s. lýsi eða fjölvítamín ef þú tekur slík.
- Hvernig er brauðið smurt? Tegund og magn
- Álegg á brauðinu og gróft eða fínt brauð (gjarnan merkið)
- Tegund mjólkur og mjólkurvara – t.d. nýmjólk, léttmjólk, fjörmjólk...
- Sykur og mjólk í kaffi eða te
- Þegar um heimagerða rétti er að ræða er æskilegt að gefa lauslega uppskrift, s.s. hvernig feiti er notuð við matargerð og hvað fór í réttinn ásamt hlutföllum.
- Skrá allt meðlæti með mat, þar á meðal sósur.

Ef þú hefur frekari spurningar er þér velkomið að hafa samband við Söndru Jónasdóttur, íþróttafræðing og MSc-nema, sem sér um þennan hluta rannsóknarinnar.
sandjona@khi.is, sími: 865-0774.

Gangi þér vel!

Nafn þátttakanda:

Kennitala:

1

Dagur: ______________________________ *(dagsetning og vikudagur)*

Klukkan	Hvað borðað og drukkið	Tegund/merki

Uppskriftir og athugasemdir:

2

Dagur: ____________________________ *(dagsetning og vikudagur)*

Klukkan	Hvað borðað og drukkið	Tegund/merki

Uppskriftir og athugasemdir:

2

Dagur: ______________________________ *(dagsetning og vikudagur)*

Klukkan	Hvað borðað og drukkið	Tegund/merki

Uppskriftir og athugasemdir:

2