JYU DISSERTATIONS 56

Tiia Kekäläinen

Leisure Activities and Well-being in Midlife and Older Age with Special Reference to Physical Activity and Resistance Training

UNIVERSITY OF JYVÄSKYLÄ
FACULTY OF SPORT AND
HEALTH SCIENCES

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Esitetään Jyväskylän yliopiston liikuntatieteellisen tiedekunnan suostumuksella
julkisesti tarkastettavaksi yliopiston Liikunnan salissa L304
maaliskuun 8. päivänä 2019 kello 12.

Academic dissertation to be publicly discussed, by permission of
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JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

JYVÄSKYLÄ 2019

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Permanent link to this publication: http://urn.fi/URN:ISBN:978-951-39-7677-4

ISBN 978-951-39-7677-4 (PDF)
URN:ISBN:978-951-39-7677-4
ISSN 2489-9003

ABSTRACT

Kekäläinen, Tiia
Leisure activities and well-being in midlife and older age with special reference to physical activity and resistance training
Jyväskylä: University of Jyväskylä, 2019, 97 p.
(JYU Dissertations
ISSN 2489-9003; 56)
ISBN 978-951-39-7677-4 (PDF)
Finnish summary
Diss.

Participation in leisure activities is related to better well-being. Participation in leisure time physical activity also has several positive effects on functional capacity and health. Notwithstanding, only a minor proportion of adults, including older adults, participate in physical activity at a sufficient level for maintaining or improving their health. This study investigated both cross-sectional and longitudinal associations between different types of leisure and physical activities and well-being.

This dissertation is based on data from three research projects: the Finland 2014 – Consumption and Lifestyle postal survey, conducted with a random sample representative of the Finnish adult population (n=1354); data collected at ages 42 and 50 (n=303) as part of the Jyväskylä Longitudinal Study of Personality and Social Development; and the Minimum Resistance Training Frequency study, which was a randomized controlled trial including a nine-month supervised resistance training program for older adults aged 65-75 (n=104). Leisure activities and well-being were measured by self-report questionnaires.

The cross-sectional results showed that, in general, leisure activities and leisure time physical activity were related to better current well-being in midlife and older age. The longitudinal results, in turn, showed that higher mental well-being predicted later participation in leisure time physical activity in midlife, not vice versa. The resistance training intervention improved some components of well-being and some exercise-related motivational and volitional characteristics among older adults. Moreover, improvements in these motivational and volitional characteristics predicted later participation in resistance training.

This research indicates that the associations between leisure activities including leisure time physical activity and well-being are complex. More attention should be paid to well-being and motivational characteristics as predictors of physical activity.

Keywords: well-being, leisure activities, physical activity, resistance training, midlife, old age

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TIIVISTELMÄ (FINNISH ABSTRACT)

Kekäläinen, Tiia
Liikunnan, voimaharjoittelun ja muiden vapaa-ajan aktiviteettien yhteydet hyvinvointiin keski-ikäisillä ja ikääntyneillä henkilöillä
Jyväskylä: University of Jyväskylä, 2019, 97 p.
(JYU Dissertations
ISSN 2489-9003; 56)
ISBN 978-951-39-7677-4 (PDF)
Finnish summary
Diss.

Vapaa-ajan aktiviteetteihin osallistuminen on aiemmissa tutkimuksissa yhdistetty parempaan hyvinvointiin. Vapaa-ajan fyysisellä aktiivisuudella on monia myönteisiä vaikutuksia myös toimintakykyyn ja terveyteen. Silti vain pieni osa aikuisista, mukaan lukien ikääntyneet, liikkuu terveyden ylläpidon tai parantamisen kannalta riittävästi. Tämän tutkimuksen tarkoituksena oli selvittää erilaisten vapaa-ajan aktiviteettien, erityisesti liikunnan, ja hyvivoinnin yhteyksiä keski-ikäisillä ja ikääntyneillä suomalaisilla.

Tässä väitöskirjassa hyödynnettiin kolmen tutkimusprojektin aineistoa: suomalaista aikuisväestöä edustavaa Suomi 2014 – Kulutus ja elämäntapa –kyselytutkimusta (n=1354), Lapsesta aikuiseksi –pitkittäistutkimuksen 42- ja 50-vuotiaana kerättyjä tietoja (n=303) sekä 65-75-vuotiaille kohdistetun Voimaharjoituskerrat –satunnaistetun vertailukokeen aineistoa (n=104). Vapaa-ajan aktiviteetteihin ja vapaa-ajan fyysiseen aktiivisuuteen osallistumista sekä hyvinvointia mitattiin itsearviointiin perustuen.

Poikkileikkaustutkimuksen tulokset osoittivat, että vapaa-ajan aktiviteetteihin osallistuminen ja vapaa-ajan fyysinen aktiivisuus olivat yhteydessä parempaan hyvinvointiin keski-iässä ja ikääntyessä. Pitkittäistutkimuksen mukaan korkea mielen hyvinvointi ennusti myöhempää liikunta-aktiivisuutta keski-iässä. Voimaharjoitteluinterventiolla oli myönteisiä vaikutuksia joihinkin hyvinvoinnin osa-alueisiin sekä liikuntamotivaatioon liittyviin tekijöihin. Myönteiset muutokset liikuntamotivaatioon liittyvissä tekijöissä ennustivat voimaharjoittelun jatkamista ohjatun intervention päättymisen jälkeen.

Tämän tutkimuksen perusteella yhteydet vapaa-ajan aktiviteettien, kuten liikunnan, ja hyvinvoinnin välillä ovat monimutkaisia. Mielen hyvinvointi ja liikuntamotivaatioon liittyvät tekijät olisi syytä huomioida keski-ikäisten ja ikääntyneiden liikunta-aktiivisuutta edistettäessä.

Asiasanat: hyvinvointi, vapaa-ajan aktiviteetit, fyysinen aktiivisuus, voimaharjoittelu, keski-ikä, ikääntyneet

ACKNOWLEDGEMENTS

This study was carried out at the Gerontology Research Center and the Faculty of Sport and Health Sciences in the University of Jyväskylä, Finland. My deepest gratitude goes to the supervisors of this thesis, Research Director Katja Kokko, Professor Sarianna Sipilä and Professor Terhi-Anna Wilska. Katja, you have supervised me since my master´s thesis. It has been easy to work under your encouraging and positive guidance. I highly appreciate all the time and effort you have given me. Sarianna, thank you for your highly valuable comments and advice. I always felt wiser and knew what to do next when I left your office. Terhi-Anna, thank you for giving me the opportunity to start my academic career in your project Digi50+, and for your guidance and help with especially the first article of this thesis. I want to express my special gratitude to Senior Researcher Simon Walker for the unofficial supervision. Thank you for sharing your time and knowledge with me. It was a pleasure to work in your project.

I am grateful for Professor Taina Rantanen, the main representative of gerontology and public health, and Professor Ari Heinonen, the Dean of Faculty of Sport and Health Sciences, for giving me the opportunity to be part of this great working environment. I sincerely thank the official reviewers of this thesis, Associate Professor Markus Jokela and Postdoctoral Fellow Andreas Stenling. I also want to thank Professor Ossi Rahkonen for agreeing to be my opponent in the public defense of this thesis.

I want to thank my co-authors, Professor Alexandra M. Freund and Research Director Tuija Tammelin, for your valuable comments. I also want to thank Prof. Freund for giving me the opportunity to visit your highly professional team for three months during my PhD studies. I am grateful for Professor Taru Feldt, a member of the steering group, for giving your time for meetings. I wish to thank Markku Kauppinen, MSc, and Timo Törmäkangas, PhD, for your statistical support. I warmly acknowledge Michael Freeman for language editing of the two original papers and this thesis and Anne Viljanen, PhD, for scientific editing of this thesis.

I have been lucky to do my research as a part of Gerontology Research Center and want to thank all my co-workers. I have learned a lot from both the academic and the non-academic world from our coffee table conversations. Many thanks especially to other PhD students for sharing both problems and successes, and especially for your friendship.

I am grateful for the financial support I have received for my PhD studies from the Faculty of Sport and Health Sciences, University of Jyväskylä, and from the Finnish Cultural Foundation. The Digi50+ project was funded by TEKES and Minimum resistance training frequency –project by the Ministry of Education and Culture of Finland. I am also grateful for Associations of Researchers and Teachers of University of Jyväskylä (Jytte ry) and Nordic Gerontological Federation to enable my congress trips and for the Research Council of University of Jyväskylä to make my mobility period to come true.

I want to thank all my friends and relatives for being a part of my life. It is a great resource to have such a close family around me. I want to express my sincere appreciation to my late grandmothers Annikki and Liisa, who inspired me to start studying gerontology. I wish to thank my siblings, Aki and Kati, for your help and guidance throughout my life. My warmest gratitude goes to my parents, Kaija and Tapio. I have no words to describe all the support and love I have received from you. Thank you for that. Lastly, my warmest thanks go to my spouse Ville. I have never met such an encouraging and loving person as you. You make me happy.

Jyväskylä 15.1.2019
Tiia Kekäläinen

FIGURES

TABLES

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following original publications, which will be referred to by their Roman numbers. The thesis also includes unpublished data.

I Kekäläinen T, Wilska T-A, Kokko K. 2017. Leisure consumption and well-being among older adults: does age or life situation matter? Applied Research in Quality of Life 12 (3): 671–691, doi: 10.1007/s11482-016-9483-6.

II Kekäläinen T, Freund A.M, Sipilä S, Kokko K. Cross-sectional and longitudinal associations between leisure time physical activity, mental well-being and subjective health in middle adulthood. Submitted for publication.

III Kekäläinen T, Kokko K, Sipilä S, Walker S. 2018. Effects of a 9-month resistance training intervention on quality of life, sense of coherence, and depressive symptoms in older adults: randomized controlled trial. Quality of Life Research 27 (2): 455–465, doi: 10.1007/s11136-017-1733-z.

IV Kekäläinen T, Kokko K, Tammelin T, Sipilä S, Walker S. 2018. Motivational characteristics and resistance training in older adults: A randomized controlled trial and 1-year follow-up. Scandinavian Journal of Medicine & Science in Sports 28 (11): 2416-2426, doi: 10.1111/sms.13236.

As the first author of the original publications, taking into account the comments from the co-authors, the author of the thesis drafted the study questions and designs for the publications, prepared the data for statistical analyses, performed all statistical analyses and took the main responsibility of writing the manuscripts. The author actively participated in the data collection in Minimum resistance training frequency -study, of which data is used in studies III and IV. The author had the main responsibility for planning and carrying out interviews for participants as well as saving and preparing the data from interviews. The data collected from interviews was used in Study IV. In Studies I and II I the author was priviledged to use pre-existing data.

ABBREVIATIONS

CFI	Comparative fit index
CG	Control group
df	Degrees of freedom
FSD	Finnish Social Science Data Archive
GEE	Generalized estimation equation
HrQoL	Health-related quality of life
JYLS	Jyväskylä longitudinal study of personality and social development
LTPA	Leisure time physical activity
MRTF	Minimum resistance training frequency -study
p	p-value, indicator of statistical significance
QoL	Quality of life
RCT	Randomized controlled trial
RMSEA	Root mean square error of approximation
RT	Resistance training
RT1-3	Resistance training 1-3 times-a-week groups
sd	Standard deviation
SEM	Structural equation modelling
SoC	Sense of coherence
SRMR	Standardized root mean square residual

CONTENTS

1 INTRODUCTION

According to Aristotle, every action is taken to achieve something good (Aristotle 2009). The highest good is something that is desirable for itself and not desirable because of some other good, and all other goods are desirable for its sake. For Aristotle, this highest good was *living well* or in other terms *happiness* and *eudaimonia*. At the subjective level, well-being indicates how good people think their life is (Diener 1984). Well-being can be seen as a construct that comprises evaluations of different life domains (Halleröd & Seldén 2013). These subjective evaluations are associated with many objective outcomes, such as mortality and health (Chida & Steptoe 2008, Diener & Chan 2011): people with better well-being seem not only to have happier lives but they also tend to live longer and healthier lives. They also spread happiness around them (Fowler & Christakis 2008).

Although well-being is rather stable in adulthood (e.g., Ehrhardt, Saris & Veenhoven 2000, Kokko et al. 2013) and at least partly based on inherent characteristics, such as personality (Diener & Lucas 1999, Steel, Schmidt & Shultz 2008, Kokko, Tolvanen & Pulkkinen 2013), many life circumstances, resources and choices are related to well-being (Hagerty et al. 2001). One of these is leisure. Aristotle stated that things done during leisure can be done for their own sake, and therefore happiness is dependent on leisure (Aristotle 2009). In midlife, leisure time is often limited owing to many duties related to work, family and society (Lachman 2004). Leisure activities may be an important way to relax and recover from these duties (Sonnentag & Bayer 2005). In addition, leisure activities offer possibilities to experience feelings of mastery, autonomy and meaning (Newman, Tay & Diener 2014) and are therefore important to both the working age population and those outside it, such as older adults. Previous studies have shown that participation in activities, especially "active" leisure activities, is related to better well-being (Brajša-Žganec, Merkaš & Šverko 2011, Pagán 2015, Schmiedeberg & Schröder 2017).

Besides well-being, leisure activities also have physical benefits. Physical activity, for example, is one of the most important leisure activities for maintaining physical functioning and health. Among other benefits, physical

activity decreases the risk for diseases such as coronary heart disease, type 2 diabetes mellitus and dementia as well as all-cause mortality (Warburton et al. 2010, Reiner et al. 2013). Cross-sectionally, leisure time physical activity is also associated with better well-being; the longitudinal associations, however, have been less studied (Wiese, Kuykendall & Tay 2018).

In older age, age-related losses in cardiovascular and muscular function expose people to functional limitations, disability and reduced exercise capacity (Morley et al. 2001, Chodzko-Zajko et al. 2009, Cruz-Jentoft et al. 2010). These age-related losses could be delayed or even prevented by exercise (Chodzko-Zajko et al. 2009). Participation in regular resistance training can maintain and increase muscle strength, power and mass in all age groups and is beneficial for functional capacity (Hunter, McCarthy & Bamman 2004, Garber et al. 2011). Better strength and cardiorespiratory fitness are also related to better well-being (Sayer et al. 2006, Sloan et al. 2009, Samuel et al. 2012). Exercise interventions not only have physical benefits but may also improve well-being (Arent, Landers & Etnier 2000, Rhyner & Watts 2016). However, despite the well-known benefits of leisure time physical activity and resistance training, only a small proportion of middle-aged and older adults participate in physical activity at a sufficient level to positively influence their health (Bennie et al. 2017).

The purpose of this study was to investigate the associations between leisure activities and well-being among middle-aged and older adults. Of the various leisure activities studied, leisure time physical activity and resistance training were examined in more detail. While no clear definition exists as to the point at which middle age starts or when middle age becomes old age, midlife is commonly considered as the years between ages 40 and 60 (Lachman, Teshale & Agrigoroaei 2015), and the onset of old age as occurring between ages 60 to 65 (e.g., Gorman 1999). In the present research project, these age frames were adopted with the focus on adults in midlife (40- to 60-year-olds) and early old age (60/65- to 75-year-olds).

2 REVIEW OF THE LITERATURE

2.1 Well-being

2.1.1 The concept of well-being

Well-being is a complex term that is widely used but not consistently defined across studies. It is used to capture multiple factors related to both psychological characteristics and physical health indicators (Linton, Dieppe & Medina-Lara 2016). In addition to the inconsistency in the definition and content of well-being, its relation to other similar concepts, such as health and quality of life is also far from clear.

First, when trying to make a sense of well-being, it should be noted that well-being can be viewed as both a subjective and an objective construct (e.g., World Health Organization 2013). When the interest is in well-being on the societal level, the term is used to cover different objective aspects of how the population of interest is doing compared to other populations. In the OECD framework, well-being includes, for example, material conditions (e.g., income, housing), health status, environmental quality and education. However, when studying well-being at the subjective level, measurements such as income and environmental quality are inadequate indicators of well-being. People have a tendency to adapt to different situations and may, for example, evaluate their well-being as good despite suffering from chronic diseases or having low education (Diener & Suh 1997). Thus, in contrast to the objective approach, subjective well-being is a personal experience, meaning that it is informative about how individuals perceive and evaluate their lives (Diener & Ryan 2009). The present research focuses solely on subjective well-being, and henceforth, unless otherwise stated, the term well-being refers to subjective well-being.

Second, the concept of well-being should be separated from that of the absence of ill-being. As health is not just the absence of disease, well-being much more than merely the absence of ill-being (Keyes 2005, Seligman 2008). Although well-being and ill-being are not opposite ends of a continuum, this

does not mean that illness should be totally separated from well-being (Keyes 2005). For example, Seligman (2008) includes both positive (e.g., life satisfaction, sense of energy and optimism) and negative (absence of bothersome symptoms) aspects in the concept of positive health.

Dimensions of well-being

The idea of well-being seems to differ between research fields. Most of the work on defining well-being has been done in psychology, where well-being is predominantly investigated as a mental construct. The debate on mental well-being has its origins in the perspectives of hedonic and eudaimonic well-being (for a review, see Ryan & Deci 2001). From the hedonic viewpoint, well-being is a measure of personal happiness and pleasure (Ryan & Deci 2001). A widely used hedonic model is the model of subjective well-being proposed by Diener et al. (1999). This model includes emotional responses, both the presence of positive mood and absence of negative mood, and cognitive evaluations, i.e., satisfaction with life. Diener uses the term "subjective well-being" to capture this hedonic side of well-being (Diener & Ryan 2009). However, since other dimensions of well-being are also subjectively evaluated, the term "emotional well-being" has also been used (Keyes 2005, Kokko et al. 2013). In this study, the term emotional well-being is used to reflect this area of well-being.

From the eudaimonic viewpoint, well-being is not attained only through pleasure; instead, well-being occurs when people live as their true selves (Waterman 1993). This approach is captured in the term psychological well-being developed by Ryff (Ryff 1989, Ryff & Keyes 1995). Psychological well-being has six dimensions: self-acceptance, positive relations with others, environmental mastery, autonomy, purpose of life and personal growth (Ryff 1989, Ryff & Keyes 1995). Keyes (2005) subsequently merged emotional well-being and psychological well-being in the tripartite model of well-being. Keyes (1998) argued that while emotional and psychological well-being are largely private features of well-being, humans are also part of communities and social structures. He therefore included social well-being in the tripartite model. Social well-being comprises five dimensions: social integration, social acceptance, social actualization, social coherence and social contribution (Keyes 1998). In this study, the term mental well-being, used by Kokko et al. (2013), refers to this same tripartite model of well-being that comprises emotional, psychological and social well-being. This structure has been confirmed in both cross-sectional and longitudinal studies (Gallagher, Lopez & Preacher 2009, Robitschek & Keyes 2009, Kokko et al. 2013).

However, well-being can be considered a broader concept than just mental well-being. For example, Swedish panel data from adults aged 55+ revealed five domains of well-being: health, functioning, social relationships, psychosocial and economic (Halleröd & Seldén 2013). There are also differences between disciplines: in the health and medical sciences, the physical and mental aspects of well-being are primarily of interest, whereas in economics, economic well-being is the predominant concern. Unlike mental well-being, these other

domains of well-being are less theoretically defined and instead based on measurements and empirical evidence.

The term physical well-being has been used in different meanings. The first is the subjective feeling of a physical state, such as energy and vigor as positive aspects and different symptoms as negative aspects (Seligman 2008, Linton, Dieppe & Medina-Lara 2016). The second meaning relates more to functionality and the individual's environment, and includes the ability to move and to participate in social roles (Capio, Sit & Abernethy 2014, Linton, Dieppe & Medina-Lara 2016). In a third meaning, physical well-being is seen as synonymous with subjective health (Halleröd & Seldén 2013). However, physical well-being is rarely defined in research and more commonly used to separate subjective physical measurements from psychological ones.

Personal circumstances can be seen both as predictors of mental well-being or as one dimension of well-being (Felce & Perry 1995). As a dimension of well-being, it reveals individuals' subjective evaluations of different socioeconomic and environmental factors in their lives, such as their economic situation, i.e., economic or financial well-being (Joo 2008, Halleröd & Seldén 2013, Linton, Dieppe & Medina-Lara 2016, Sorgente & Lanz 2017). In sum, while no clear definition of well-being exists, it is generally conceded that it is a multi-dimensional construct (Leadbetter & O´Connor 2013, Linton, Dieppe & Medina-Lara 2016).

Relationship between well-being and other similar concepts

When defining well-being, related concepts, such as health and quality of life, should also be considered. This has also been noticed by the World Health Organization´s expert group, who concluded that the next steps in measuring well-being should include its differentiation from other terminology, such as quality of life (World Health Organization 2013). How the associations between these concepts are considered in this research is presented in Figure 1.

The relationship between well-being and health is complex. The well-known definition of health by the World Health Organization (1948) that "*Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*" already includes the word well-being. Their expert group has since tried to clarify the association between the concepts of well-being and health (World Health Organization 2013). On one hand, if well-being is understood as a composite that combines different elements and measures, then health is a component of well-being. This was also the case in the above-mentioned study on Swedish panel data, where health was a dimension of well-being (Halleröd & Seldén 2013). On the other hand, if well-being is understood as a concept in itself, health is a distinct factor that affects well-being (World Health Organization 2013). The relationship between these concepts is strongly dependent on the dimensions of both well-being and health: if health solely indicates a physical state, it could be used as a synonym for physical well-being and a dimension of overall well-being. If, however, health includes physical, mental and social dimensions, as in the World Health Organization´s definition

(1948), it is even harder to draw a line between mental health and mental well-being, social health and social well-being, and physical health and physical well-being. As health is usually measured with both self-ratings and objective indicators, it can be concluded that the dimensions of well-being are very close to the dimensions of subjective health.

As with health, the concept of quality of life (QoL) is also hard to separate from well-being. QoL has different meanings when viewed from the societal compared to individual level (Camfield & Skevington 2008). It has been described as an umbrella term that covers all the dimensions of well-being, such as the physical, social, emotional and material (Felce & Perry 1995, Diener & Ryan 2009). It combines life conditions (objective aspect) and personal satisfaction with them (subjective aspect) (Felce & Perry 1995). The World Health Organization (1998) defines QoL as an "individual´s perceptions of position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns". On this definition, QoL is a subjective evaluation of life and comes very close to the definition of subjective well-being by Diener and Ryan (2009). A difference between the terms is that well-being research has taken a more theoretical perspective while the research on QoL has focused more on methodological development (Camfield & Skevington 2008). QoL is especially used in medical science to investigate treatment outcomes (Rejeski & Mihalko 2001). QoL is often divided into different dimensions, such as the physical, psychological, social and environmental (World Health Organization 1998), which are very close to the corresponding dimensions of well-being. In sum, it is not possible to draw conclusions about whether well-being is a synonym or a dimension of QoL, or a separate construct altogether (Camfield & Skevington 2008, Dodge et al. 2012, Leadbetter & O´Connor 2013).

Moreover, another concept, that of health-related quality of life (HrQoL), overlaps with both health and QoL (Karimi & Brazier 2016). Like general QoL, HrQoL reflects an individual´s subjective experiences and perceptions of life; however, the focus is on the effect of health on overall QoL (Wilson & Cleary 1995). HrQoL has been defined as "the extent to which one's usual or expected physical, emotional, and social well-being is affected by a medical condition and/or treatment" (Cella 1995). HrQoL is used mainly in health care research as a treatment outcome (Wilson & Cleary 1995). Finally, the term wellness is sometimes used interchangeably with well-being. According to online dictionaries (Cambridge Dictionary), it refers to the state of being healthy; however, it is less used and has not been defined in research. For example, Web of Science (24.5.2018) found over 3 000 hits for "wellness" in research publication titles compared to over 25 000 hits for "well-being" or "wellbeing".

In this study, the term well-being refers to all these subjective evaluations. The multidimensionality of well-being is captured by investigating the mental (including emotional and social), physical and economic dimensions of well-being and the physical, psychological, social and environmental dimensions of QoL.

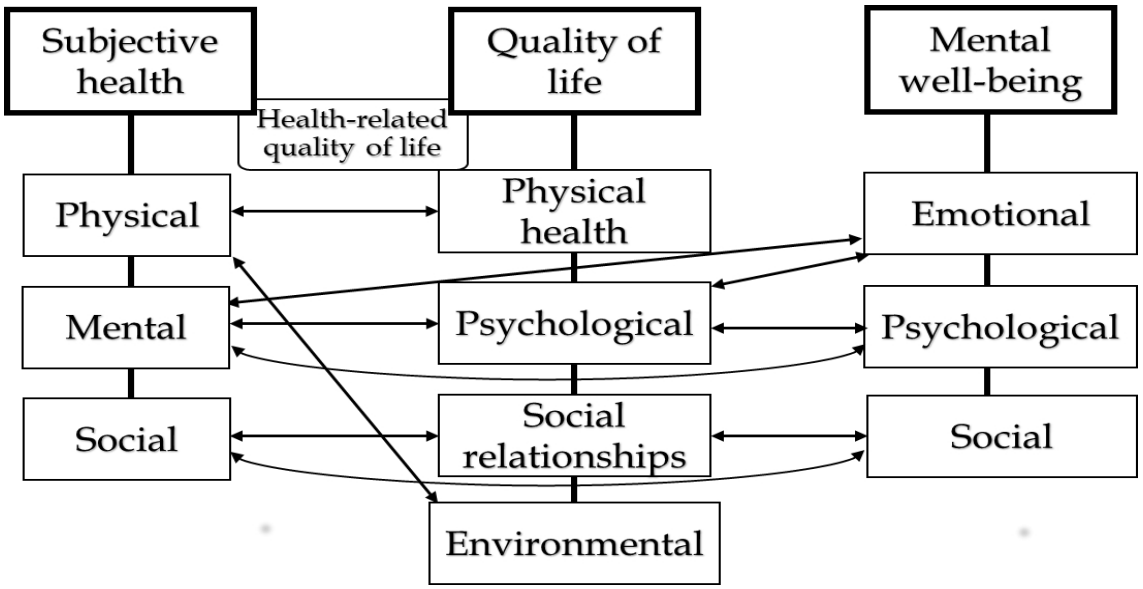

FIGURE 1 The relationships between the terms subjective health, quality of life and mental well-being as seen in the present research. The dimensions of health and quality of life are adopted from World Health Organization reports (World Health Organization 1948, World Health Organization 1998) and those of mental well-being (Kokko et al. 2013) from Keyes´ tripartite model (Keyes 2005).

Measuring well-being

Because well-being reveals people´s perceptions about their lives (Diener & Ryan 2009), people themselves are the best qualified to evaluate it. Self-reports are the commonest way to measure well-being (Diener 1994). The multiple use of the term well-being is evident in the number of ways used to measure it. In their review, Linton, Dieppe and Medina-Lara (2016) found 99 different self-report measures for assessing well-being. Usually, the focus of well-being studies is on long-term well-being rather than moment-to-moment fluctuations in well-being (Diener 1994).

The types of questionnaires assessing well-being or similar concepts, such as QoL, vary from questionnaires on overall well-being to questionnaires on more detailed aspects of well-being. For example, questions on life satisfaction may ask about different life domains, such as leisure, work and financial situation (Kokko, Tolvanen & Pulkkinen 2013). Moreover, satisfaction in these life domains can be studied in greater detail. For example, a leisure satisfaction questionnaire can assess satisfaction with leisure in specific sub-domains such as the psychological, educational, social, relaxational, physiological and aesthetic (Beard & Ragheb 1980, Trottier et al. 2002).

Multiple questionnaires have been used to assess dimensions of mental well-being that have shown good psychometric properties. The list includes, among others, the Satisfaction of Life Scale (Diener et al. 1985), Profile of Mood States (PoMS) (Shacham 1983), Positive and Negative Affect Schedule (PANAS)

(Watson, Clark & Tellegen 1988), Scales of Psychological Well-Being (Ryff 1989) and Scales of Social Well-Being (Keyes 1998). Compared to mental well-being, fewer questionnaires have been used to assess the other dimensions. The most commonly used measurement of physical well-being is self-rated health (Eriksson, I., Undén & Elofsson 2001), in which people are asked to evaluate their health status or to compare their health-status to that of their age-peers by means of a single question (Jylhä 2009). Answering such a single question is not as simple as it may sound. Based on the conceptual model of self-rated health by Jylhä (2009), answering the question "How is your health in general?" is a cognitive process that includes evaluation of the meaning of health, comparison of one's health status against one's age, against that of other people and against one's own previous health and health-related expectations, and of making a choice between response alternatives based on cultural conventions. Subjective economic well-being and satisfaction with other personal circumstances are usually measured as part of broader questionnaires measuring different domains of well-being (Linton, Dieppe & Medina-Lara 2016). Questionnaires focusing exclusively on these domains, such as the Financial Distress/Financial Well-Being Scale (Prawitz et al. 2006) are also used, although to a lessor extent.

In addition to numerous questionnaires assessing single aspects of well-being, broader questionnaires are available that seek to capture the whole phenomenon at one stroke. These include, for example, the Personal Well-Being Index (The International Wellbeing Group 2013) and scales measuring QoL (e.g., the WHOQOL (World Health Organization 1998)) and HrQoL (e.g., SF-36/RAND-36 (Hays, Sherbourne & Mazel 1993, Chang, C. et al. 2007)). As a general rule, well-being should be measured with multiple measures to reduce the risk of measurement errors and to ensure coverage of the multiple components of the phenomenon (Diener 1994).

2.1.2 Well-being in midlife and older age

Stability of well-being in adulthood

Mental well-being is considered to show high stability in adulthood. However, it is important to distinguish between absolute and relative stability. Absolute stability refers to the degree to which an individual´s well-being over time remains unchanged whereas relative (rank-order) stability refers whether an individual's well-being ranking changes or remains unchanged in relation to other individuals in a group (Ehrhardt, Saris & Veenhoven 2000).

Studies investigating rank-order stability have mainly been conducted with single concepts of mental well-being. Moderate to high stability in adulthood has been found for life satisfaction (Ehrhardt, Saris & Veenhoven 2000), psychological well-being (Ryff, Radler & Friedman 2015, Joshanloo 2018) and social well-being (Joshanloo, Sirgy & Park 2018). These concepts have also shown high stability. For example, Kokko et al. (2013, 2015) found that when mental well-being was captured by a latent factor comprising emotional and psychological well-being, absence of depressive symptoms and, in a later analysis, also social well-being, it showed high stability from age 36 to 42

(β=0.84), and from age 42 to 50 (β=0.84). Group-level comparisons on the absolute stability of mental well-being have shown that emotional well-being may display a U-shaped curve, decreasing from early adulthood to midlife and increasing thereafter (Blanchflower & Oswald 2008, Frijters & Beatton 2012). Other longitudinal studies have found that some mental well-being indicators, such as positive mood and life satisfaction, may increase during middle-adulthood (Kokko et al. 2013, Kokko, Tolvanen & Pulkkinen 2013).

Self-rated health is the most commonly studied component of physical well-being. It is suggested that while self-rated health does not have a specific genetic effect of its own, genes influence self-rated health via chronic diseases, functional limitations and mood (Leinonen et al. 2005). Self-rated health has rather high rank-order stability (five- to ten-year correlations of approximately 0.60) (McCullough & Polak 2006) comparative and longitudinal studies on absolute change in both age groups suggest that self-rated health tends to decrease with age (Andersen, Christensen & Frederiksen 2007, Spuling et al. 2015). This decrease in self-rated health with age is mostly explained by illness (Svedberg et al. 2005, Spuling et al. 2015). Other dimensions of well-being have been less studied, but satisfaction with financial situation, i.e., economic well-being, for example, tends to increase with age despite the fact that financial situation usually declines with age (Seghieri, Desantis & Tanturri 2006)

Dispositional traits as a basis for well-being

As rank-order stability, especially, in well-being, is high in adulthood, it is worth considering the reasons for it. A study comparing German and British panel data reported that 34−38% of the variance in life satisfaction is unchangeable trait variance and that 29-34% is moderately stable autoregressive variance (Lucas & Donnellan 2007). This unchangeable trait variance is associated with dispositional traits that are relatively decontextualized and show high stability during the life course (McAdams 1995). These dispositional traits include, for example, personality traits (Diener & Lucas 1999, Diener, Oishi & Lucas 2003), optimism (Scheier & Carver 1985), and sense of coherence (SoC) (Antonovsky 1987). These are all closely related to well-being (Eriksson, M. & Lindström 2007, Conversano et al. 2010, Kokko, Tolvanen & Pulkkinen 2013, Kokko, Rantanen & Pulkkinen 2015). Of them, only SoC was included in the present research.

SoC is part of Antonovsky´s (1987) salutogenic model. It is a global orientation measuring the extent to which life is perceived as comprehensive, manageable and meaningful. As in the case of well-being and personality, SoC shows high stability in adulthood (Feldt et al. 2007) and is therefore considered a rather inherent characteristic. SoC is not only closely related to self-rated health and QoL but is also a resource for these (Eriksson, M. & Lindström 2006, Eriksson, M. & Lindström 2007). The association of SoC with mental well-being has been less studied, but cross-sectional studies have shown SoC to be positively linked to different components of mental well-being, such as life

satisfaction and positive affect (Pallant & Lae 2002, von Humboldt, Leal & Pimenta 2015).

Ways to improve well-being in midlife and early old age

Ways to improve well-being in a larger framework can be found in the system theory proposed by Hagerty et al (2001). A version of the theory, adapted for use in the present context, is presented in Figure 2. The system theory seeks to explain quality of life via the relationship between the environment and the individual. The theory comprises three levels: input, throughput and output. Subjective experience of well-being is seen as an outcome (output) in the model and is divided into different dimensions, such as family and friends, emotional well-being, health and material well-being (Hagerty et al. 2001). These are very close to the dimensions of well-being discussed earlier. In this dissertation research, the dimensions used are labeled emotional, psychological, social, physical and material well-being.

Well-being is an outcome of various input and throughput variables. The input variables are informative about the quality of the environment (Veenhoven 2000). The resources available to the individual, such as education and health services, are among these input variables (Hagerty et al. 2001). These variables are related to the welfare provision and living standard in the individual's society (Veenhoven 2000). Personality is also included among the input variables (Hagerty et al. 2001).

According to the system theory, individuals´ responses to their environment and their choices contribute to the experience of well-being (Hagerty et al. 2001). These choices are termed throughput variables and include, for example, level of education and marital choice, and also personal health and consumption (Hagerty et al. 2001). This idea contrasts with the traditional set-point theory of well-being (aka the hedonic treadmill) (for a review, see Diener, Lucas & Scollon 2006), which suggests that the influence of life events on well-being is only temporary: after a while, an individual´s well-being returns to their baseline level. However, the set-point theory has not been empirically supported: life choices, such as one's partner, the tradeoff between work and leisure, and a healthy lifestyle, have been related to longitudinal changes in well-being (Headey, Muffels & Wagner 2010).

In midlife, the major challenges to well-being are the multiple responsibilities related to family, work and society (Lachman 2004, Lachman, Teshale & Agrigoroaei 2015). In the transition from midlife to older age, retirement is one of the biggest life changes: work-related resources and roles disappear or decrease (Henning, Lindwall & Johansson 2016). Adapting to the new situation may contribute not only to current but also to long-term well-being. However, longitudinal studies have shown that while most people maintain their level of well-being during retirement, there is considerable heterogeneity in this phenomenon (Henning, Lindwall & Johansson 2016). In both midlife, when responsibilities take up a lot of time, and in early older age, when work occupies less time, leisure could be one of the personal choices that

contribute to well-being. Therefore, in the present research, leisure activities and leisure time physical activity were investigated as potential throughput variables that are related to higher well-being.

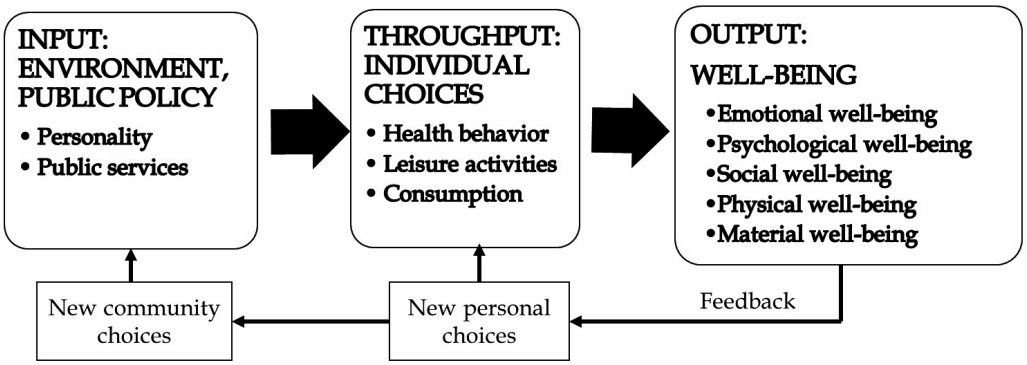

FIGURE 2 The system theory of quality of life (Hagerty et al. 2001) adapted to the context of the present research.

2.2 Leisure activities and leisure time physical activity

2.2.1 The concepts of leisure and leisure time physical activity

Leisure

Leisure can be defined as "free time", i.e., the time that remains after obligations have been met (Shivers & deLisle 1997, p. 93-94). Work is the most important obligatory task and has traditionally been seen as the opposite of leisure, whereas the other obligatory tasks include life maintenance tasks, such as sleeping and eating, taking care of family members and household duties. Leisure differs from obligatory tasks in its nature: freedom and choice are the main characteristics of leisure. It is the time when people can do what they choose (Shivers & deLisle 1997, p. 93-94), at least to some extent as leisure can be affected by many constraints, such as time and money, available resources, other people´ opinions, and limited knowledge of the possibilities for spending it (Best 2010, p. 4).

Defining leisure as free time does not reveal much about how it is spent. Free time could be used for freely chosen purposes or not used for anything in particular. However, it is often defined by activity and investigated as participation in specific leisure activities (Shivers & deLisle 1997, p. 96-100). The problem of investigating leisure as participation in leisure activities is the sheer number of ways of spending leisure time. To overcome this difficulty, different categorizations of leisure activities have been used. Leisure activities have been divided, for example, into social and solitary activities or into active and passive activities (Adams, Leibbrandt & Moon 2011, Ku, Fox & Chen 2016). Besides its physical modes, active leisure can include mental, social and cultural pursuits.

Leisure time physical activity and exercise

Physical activity and exercise are closely related terms that are sometimes confused. Physical activity is defined as any bodily movement that is produced by skeletal muscles and increases energy expenditure (Caspersen, Powell & Christenson 1985, Chodzko-Zajko et al. 2009). The simplest way is to divide physical activity into work-related or occupational physical activity and leisure time physical activity (LTPA) (Caspersen, Powell & Christenson 1985). If leisure is conceived as simply as time outside of work, all the other physical activity domains will be subsumed under LTPA. However, domestic physical activity, such as housework, is often separated from LTPA. Additionally, physical activity that occurs between work and leisure time, i.e., commuting, could be seen as a category of physical activity of its own. While physical exercise meets the criteria for physical activity, it can also be planned, structured and repetitive with the aim of maintaining or improving physical fitness (Caspersen, Powell & Christenson 1985, Chodzko-Zajko et al. 2009). Exercise is a subtype of physical activity and can occur in all categories of physical activity, although it most commonly takes place during leisure time (Caspersen, Powell & Christenson 1985).

Global and national physical activity guidelines recommend that both adults (aged 18-65) and older adults (aged 65+) should participate in both aerobic (i.e. endurance) and muscle strengthening exercises (Haskell et al. 2007, U.S. Department of Health and Human Services 2008, Chodzko-Zajko et al. 2009, World Health Organization 2010). These guidelines specify the minimum level of physical activity required to maintain health and physical fitness while amounts above these guidelines offer additional benefits. Aerobic activities should be done in bouts of at least 10 minutes at moderate intensity for at least 150 minutes per week or at vigorous-intensity for at least 75 minutes per week, or a combination of these. Moderate-intensity activities accelerate the heart rate and include, for instance, brisk walking and heavy housework like vacuuming. Vigorous activities, such as jogging and skiing, cause a considerable increase in the heart rate and induce shortness of breath (Haskell et al. 2007). Benefits from aerobic exercises include, for example, improvements in aerobic exercise capacity and cardiovascular functioning (Chodzko-Zajko et al. 2009).

Muscle-strengthening activities should be done at least twice weekly on nonconsecutive days (Haskell et al. 2007, Chodzko-Zajko et al. 2009). Such activities include progressive strength training, calisthenics, stair climbing and other resistance exercises for the major muscle groups (Chodzko-Zajko et al. 2009). Muscle-strengthening activities are an effective way to improve the functional capacity of the neuromuscular system, including improvements in strength, power and muscle endurance (Deschenes & Kraemer 2002). To maximize strength gains, progressive RT programs are recommended. As the body easily adapts to regularly conducted training, the training program should be modified at regular intervals to remain challenging and to maintain an effective training stimulus (Ratamess et al. 2009). Ways to implement progressive training include training overload, variation and specificity: to

challenge and stress the body, the training stimulus has to vary, e.g., by periodization, and the training should be designed specifically to match training goals (Ratamess et al. 2009). These principles apply to healthy adults, including older adults, whereas special attention should be paid to populations with diseases or physical function-limiting conditions, such as cardiovascular diseases (Ratamess et al. 2009). In addition to aerobic and muscle-strengthening exercise, guidelines for older adults include flexibility training at least twice weekly. The purpose of flexibility training is to preserve or extend the range of motion around a joint (Chodzko-Zajko et al. 2009). Furthermore, for older adults with mobility decline or a frequent fall history, balance exercises at least twice weekly are recommended (Chodzko-Zajko et al. 2009).

Measuring leisure activities and physical activity

The main problematic issue in the research on leisure activities concerns the large number of different activities and ways of operationalizing them. Newman, Tay and Diener (2014) make a distinction between structural leisure and subjective leisure. In both types, leisure can be measured as the amount of time spent on, the diversity of, or the frequency of engagement in different leisure activities. The difference between these two types of leisure is that structural leisure is defined externally and subjective leisure internally: structural leisure is measured using a list of activities presented by the researcher, whereas subjective leisure focuses on activities that individuals perceive as leisure (Newman, Tay & Diener 2014). For example, although watching TV is the commonest way of spending leisure time (OECD 2009), it might not come to mind when people are asked about their leisure activities. However, in research, structural leisure has usually been studied, as it is easier to measure leisure activities with pre-designed questionnaires (Kuykendall, Tay & Ng 2015)

Participation in different leisure activities can be measured using questionnaires and diaries. Both methods may assess leisure activities by diversity, frequency and quantity (Kuykendall, Tay & Ng 2015). Although some questionnaires, such as Self-Report Activity Questionnaire (Jopp & Hertzog 2010) and Leisure Activity Involvement Scale (Ragheb 1980, Chun et al. 2012), have been developed to measure leisure activities, most studies have compiled their own list of activities. When the interest is in the diversity of activities, the simplest approach is to ask about participation in specific leisure activities and calculate the number of different activities individuals report (e.g., Kaliterna Lipovcan et al. 2018). Frequency is usually measured on a Likert-type response scale (Jopp & Hertzog 2010, e.g., Brajša-Žganec, Merkaš & Šverko 2011) and quantity by the amount of time spent on activities (Kuykendall, Tay & Ng 2015). Diaries can be used to obtain information on both frequency and quantity (e.g., Lee, J. H., Lee & Park 2014, Schmiedeberg & Schröder 2017). Compared to other self-report questionnaires, diaries are less vulnerable to measurement bias, such as social desirability and recall issues (van der Ploeg et al. 2010). In addition to frequency, diversity and quantity, questionnaires can also be used to determine

expenditure on leisure activities (e.g., DeLeire & Kalil 2010, Hudders & Pandelaere 2012). Although spending on leisure products and services means having the requisite financial resources, it may also reflect a person´s lifestyle, interests and values (Katz-Gerro 2004, Wheaton 2010). Thus, money can be viewed as an investment in leisure similar to that of time.

Whatever method is used to measure participation in leisure activities, the choice remains of focusing on separate activities, merging activities to create fewer categories (e.g., Brajša-Žganec, Merkaš & Šverko 2011) or calculating overall participation (e.g., Paggi, Jopp & Hertzog 2016). Each has its own disadvantages. Separate activities and activity categories are only informative about participation in specific activities and not about the totality of leisure activities. On the other hand, if only one activity is of importance to an individual, the scores for diversity and frequency will be very low (Kuykendall, Tay & Ng 2015). The usefulness of measurements also depends on the type of activity: for example, the average frequencies of watching TV, meeting friends and going on vacation will clearly be different.

In the case of physical activity, four factors have to be considered when making measurements: activity type, frequency, duration and intensity (Sylvia et al. 2014). Ways of assessing physical activity participation include self-report questionnaires, diaries and direct measures/devices. Of these, self-report questionnaires are the most commonly used, cost-effective and easiest way to measure participation (Sylvia et al. 2014). Many validated questionnaires on physical activity are available, such as the International Physical Activity Questionnaire (IPAQ) (Craig et al. 2003) and the Global Physical Activity Questionnaire (QPAQ) (Armstrong & Bull 2006, Wanner et al. 2017). The first asks about the frequency and duration of physical activity during the previous seven days (IPAQ) and the second about the frequency and duration of physical activity related to work, travel and leisure during a typical week (QPAQ). Although self-report is an easy way to obtain information about physical activity patterns and rank individuals in their physical activity behavior, it is considered to be less robust, especially for measuring light or moderate activity and energy expenditure, than electronic monitoring devices (Sylvia et al. 2014, Ndahimana & Kim 2017). In addition, questionnaires and diaries that are not completed in real time are dependent on the respondent´s memory and may be subject to social desirability bias (Sylvia et al. 2014).

In addition to self-report measures, physical activity, sedentary behavior and energy expenditure can be measured directly. The most accurate methods of measuring energy expenditure include the double-labeled water (DLW) method and direct and indirect calorimetry. However, these methods are all high cost, and are mainly used in laboratory settings (Ndahimana & Kim 2017). Lower cost and more non-invasive methods include devices such as accelerometers, pedometers and heart rate monitors. These devices can also capture shorter activity bouts that are often omitted in self-reports and remove the risk of recall errors (Sylvia et al. 2014, Ndahimana & Kim 2017). However, these devices require technical expertise and have some disadvantages. For

example, reliable data are dependent on the participant´s proper use of the device, devices may not capture all movements accurately, and devices do not give information on contextual issues, such as type of physical activity (Sylvia et al. 2014, Ndahimana & Kim 2017). While self-report questionnaires are vulnerable to social desirability bias, the use of monitoring devices may cause participants to be more active than they normally are (Sylvia et al. 2014). The correlations between direct and indirect (self-reported) physical activity measurements have varied between studies, but on average have been low to moderate (mean r=0.37) among adults (Prince et al. 2008) and (mean r=0.38) older adults (Kowalski et al. 2012).

Predictors of participation

As most people have multiple options on how to use their leisure, it is interesting to study why some people are active and some are not. The field of health promotion has been particularly interested in the reasons behind a physically active life style. Motivation plays a key role in human behavior. According to the self-determination theory by Ryan and Deci (2000a, 2000b), motivation is a continuum from more controlled to more autonomous motivation. The different motivation styles in the continuum are termed regulation styles. Intrinsic motivation or intrinsic regulation is the most autonomous regulation style (Ryan & Deci 2000a). It reflects humans´ drive to learn, seek challenges and build one's own capabilities: an individual is interested in the activity per se, enjoys participating in it and obtains satisfaction from it. Ryan and Deci (2000a, 2000b) divide extrinsic motivation into four regulation styles: external, introjected, identified and integrated. Of these, external regulation, in which motivation is based on external demands or rewards, is the least autonomous style. Introjected regulation is also a rather controlled regulation style, but is based more on internal demands or rewards, such as avoiding feelings of guilt. In the identified regulation style, the target behavior is seen as valuable and important, and in identified regulation it is seen as a part of the individual's identity. However, the reasons for the behavior are not, as they are in intrinsic regulation, based on inherent enjoyment. According to the cognitive evaluation theory, which is a sub theory of the self-determination theory, people have three basic needs: autonomy, competence and relatedness (Ryan & Deci 2000b). If an activity satisfies these needs, it is more likely to pursued out of intrinsic motivation and to enhance well-being (Ryan & Deci 2000b). Intrinsic motivation increases the likelihood that the behavior will be continued (Standage & Ryan 2012).

However, when trying to initiate a new behavior, motivation is not always enough. Schwarzer (2008) proposed the Health Action Process Approach (HAPA) to describe the adoption of new health behavior. The approach includes a motivational phase, which leads to intention, and a volitional phase, which leads to actual behavior. A key characteristic in both the motivational and volitional phases is self-efficacy (Schwarzer 2008). Self-efficacy reveals individuals´ beliefs about their own capabilities (Bandura 1994) and it is closely

related to the basic need of competence (Ryan & Deci 2000a). Different types of self-efficacy are needed in different phases of behavior (Schwarzer 2008). In the motivational phase, optimistic beliefs about the individual´s own capabilities to initiate the new behavior (i.e., action self-efficacy) are needed whereas in the volitional phase beliefs about dealing with barriers (i.e., maintenance self-efficacy) and recovery from setbacks (i.e., recovery self-efficacy) are needed (Schwarzer 2008). In addition to motivation and self-efficacy, Schwarzer (2008) includes action and coping planning in the HAPA model as mediators between intentions and behaviors. Action plans include plans concerning when, where, how, and how often the new behavior is to be engaged in, whereas coping plans include plans concerning what to do when difficult situations arise (Sniehotta et al. 2005). Previous studies have shown that all these motivational and volitional characteristics are important when initiating and maintaining a physically active lifestyle (McAuley & Blissmer 2000, Sniehotta, Scholz & Schwarzer 2006, Teixeira et al. 2012, Standage & Ryan 2012). However, previous studies have focused mainly on aerobic exercise and shown less interest in the predictors of RT participation (Rhodes et al. 2017).

2.2.2 Leisure activities and leisure time physical activity in midlife and older age

When leisure is defined as time free from obligations, the amount of leisure varies across age and life stages. In mid-adulthood, duties related to work, children and household take a lot of time from leisure. Adults aged 45 to 64 usually have more leisure time than younger adults, probably owing to the absence of young children in this age group (OECD 2009). However, with the rise in the fertility rate of women aged 35-44 (Official Statistics of Finland 2016), individuals in the age group 45-64 vary widely in their life situations. Whereas work is often seen as the opposite of leisure and the most time-consuming task, retirement provides an opportunity for an increase in leisure time (Shivers & deLisle 1997, p. 93-97). Cross-sectional cohort comparisons in different countries have consistently shown that older adults (65+) have more leisure time than the working-age population (aged 25-64) (OECD 2009). In addition to leisure time, leisure satisfaction also tends to increase during the transition from working life to retirement (Pinquart & Schindler 2009).

In midlife, leisure activities are an important counterbalance to work (Sonnentag & Bayer 2005). A study among Finnish employees found that employees who were active in their leisure time (i.e., participated in physical, social, cultural and creative activities) recovered better from work than those who were more passive in their leisure time (de Bloom et al. 2018). People may seek both novelty and stability from leisure activities, and stability increases with age: compared to older people, younger adults more often initiate new activities whereas older people tend to continue previous activities (Iso-Ahola, Jackson & Dunn 1994). Participation in leisure activities in midlife and older age is related to the leisure activities of earlier life stages, as earlier participation in

the activity can predict later participation over as long as thirty years (Agahi, Ahacic & Parker 2006).

Leisure activities in early old age are often studied from the viewpoint of retirement. For example, while overall sedentary time decreases during the retirement transition because of reduced occupational sitting (Sprod et al. 2015), the time spent on domestic sedentary activities such as watching TV, increases (Touvier et al. 2010, Sprod et al. 2015, Leskinen et al. 2018). In addition, LTPA and exercise tend to increase during the retirement transition (Touvier et al. 2010, Barnett, van Sluijs & Ogilvie 2012). However, this increase seems to be temporary, as later during retirement physical activity levels start to decrease (Janke, Davey & Kleiber 2006, Stenholm et al. 2016). Similarly, overall leisure activity participation rates seem to decrease with age (Strain et al. 2002, Agahi, Ahacic & Parker 2006), partly because of decreases in self-rated health and functional capacity and loss of spouse (Strain et al. 2002).

This decrease in participation is also seen in the extent to which physical activity recommendations are met. According to self-reports, only 10% of Finnish adults aged 18+ meet physical activity guidelines (Bennie et al. 2017). The recommendations for muscle-strengthening activity, especially, are poorly met and the proportion of those who meet the recommendations decrease systematically with age. For example, of older adults aged 65-74, 27% reported meeting the guidelines for aerobic activity, 11% for muscle-strengthening activity and 7% for both, whereas the corresponding proportions for middle-aged adults aged 45-54 were 33%, 15% and 10% (Bennie et al. 2017). However, when daily physical activity was measured by accelometers, only around one-fifth of Finnish adults met the guidelines for aerobic activity; however, this proportion increased with age (Husu et al. 2018).

2.3 The relationships between leisure activities, leisure time physical activity and well-being in midlife and older age

2.3.1 Cross-sectional associations between leisure activities and well-being

A positive association between participation in leisure activities and well-being has been found in many cross-sectional studies. The associations vary depending on the measurements of well-being used and the type of leisure activity. For example, the meta-analysis by Kuykendall, Tay and Ng (2015) showed that, in general, participation in leisure activities was associated with better life satisfaction and positive affect, and that the association with negative affect was weak. The same result was found in a meta-analysis investigating the associations between LTPA and well-being measurements (Wiese, Kuykendall & Tay 2018).

Most of the existing studies have focused on components of emotional well-being, such as life satisfaction and happiness. In general, leisure activities

requiring active involvement have been linked to better emotional well-being. These activities include participation in social activities, such as meeting friends (Rodríguez, Látková & Sun 2008, Brajša-Žganec, Merkaš & Šverko 2011, Pagán 2015, Schmiedeberg & Schröder 2017), cultural activities, such as going to concerts and the theater (Brajša-Žganec, Merkaš & Šverko 2011, Leadbetter & O´Connor 2013, Takeda et al. 2015, Pagán 2015), voluntary work (Pagán 2015, Cho, Post & Kim 2018) and travel (Pagán 2015, Schmiedeberg & Schröder 2017, Cho, Post & Kim 2018). In addition, overall activity, measured as the mean frequency of participation in different activities, is related to both better life satisfaction and better self-rated health (Paggi, Jopp & Hertzog 2016).

The relationship between sedentary activities and well-being is less clear. In some studies, sedentary activities, such as reading, watching TV and using the internet, were related to lower levels of well-being (Brown, MacDonald & Mitchell 2015, Schmiedeberg & Schröder 2017, Kolt et al. 2017) while others have found positive associations (Pagán 2015, Ku, Fox & Chen 2016).

LTPA has been the most widely studied leisure activity, and a positive relationship between well-being and leisure time physical activities has been demonstrated in many cross-sectional population-level studies, reviews and meta-analyses. Those who regularly participate in LTPA have shown higher scores in life satisfaction, positive affect (Kuykendall 2017), physical and mental QoL (Rejeski & Mihalko 2001, Lahti et al. 2016), social well-being and self-rated health (Hassmén, Koivula & Uutela 2000, Södergren et al. 2008), and lower rates of depressive symptoms (Hassmén, Koivula & Uutela 2000) and mental burden (Chekroud et al. 2018). Previous studies have mainly focused on LTPA in general, but participation in different types of LTPA, such as walking (Oh et al. 2017, Chekroud et al. 2018), running and cycling (Chekroud et al. 2018), and outdoor activities (Wolf & Wohlfart 2014, Chang, P., Lin & Song 2018) have also been related to better well-being. The associations between different types of LTPA and different dimensions of well-being may vary: for example, among Australian national park visitors, walking and hiking contributed to stronger improvements in mental than physical well-being, whereas running was related at a similar level to both mental and physical well-being (Wolf & Wohlfart 2014). However, cross-sectional studies do not reveal whether leisure activities and LTPA precede better well-being or whether high well-being is the reason for participation in leisure activities and LTPA.

2.3.2 Longitudinal associations between leisure time physical activity and well-being

Longitudinal associations between well-being and both LTPA and other leisure activities have been less studied (Kuykendall, Tay & Ng 2015, Wiese, Kuykendall & Tay 2018). A few studies have reported that participation in LTPA at baseline has shown a positive association with well-being at follow-up (follow-up period 3-24 years) (Blomstrand et al. 2009, Ku et al. 2014, Takeda et al. 2015, Ku, Fox & Chen 2016) and with lower risk for depression (Mammen & Faulkner 2013). Blomstrand et al. (2009) found that the lower levels of LTPA at

baseline increased the risk for poorer physical and mental well-being at follow-ups 12 and 24 years later but not at 32 years later.

Changes over time have been even less studied. An increase in LTPA has been associated with increased physical and mental well-being (Blomstrand et al. 2009), physical, mental and social QoL (Tessier et al. 2007), and social QoL (Wendel-Vos et al. 2004). In sum, the longitudinal studies on LTPA and well-being have shown a positive relationship, but causality remains unclear.

2.3.3 The effect of resistance training interventions on well-being

Effects of resistance training (RT) interventions on well-being

The causal relationship from LTPA to well-being has been studied using randomized controlled trials (RCT). Previous reviews and meta-analyses have consistently shown that both general leisure interventions (Kuykendall, Tay & Ng 2015) and different types of physical activity interventions (McAuley & Rudolp 1995, Arent, Landers & Etnier 2000, Netz et al. 2005, Windle et al. 2010) are effective ways to improve well-being in adults, including older adults. In the present research, the focus is on RT interventions, as the effect RT on well-being has been less studied than that of aerobic training (O'Connor, Herring & Caravalho 2010).

Physical characteristics, such as strength and functional capacity, are usually the main outcomes in RT interventions. In previous RCTs that have also reported on psychological outcomes, measures of QoL or HrQoL have usually been used. The results of previous studies are partly inconsistent. Many studies have found positive effects of RT on QoL or HrQoL in healthy adults, including older adults (de Vreede et al. 2007, Levinger et al. 2007, Katula, Rejeski & Marsh 2008, Wanderley et al. 2013, Ramirez-Campillo et al. 2014) and in different patient groups, such as prostate (Norris et al. 2015) and breast cancer survivors (Ohira et al. 2006), MS patients (Dalgas et al. 2010), cardiac patients (Beniamini et al. 1997), and type 2 diabetics (Lincoln et al. 2011). However, some interventions have found no intervention effect on QoL or HrQoL (Damush & Damush 1999, Sillanpää et al. 2012, Bonganha et al. 2012, Ericson et al. 2018). In the studies where a positive intervention effect was found, RT usually improved the physical domain of QoL or HrQoL (Ohira et al. 2006, de Vreede et al. 2007, Levinger et al. 2007, Dalgas et al. 2010, Wanderley et al. 2013, Ramirez-Campillo et al. 2014) while in some studies improvement was also found in the mental or psychosocial domain (Ohira et al. 2006, Levinger et al. 2007, Lincoln et al. 2011, Ramirez-Campillo et al. 2014). RT interventions have also succeeded in decreasing depressive symptoms (Beniamini et al. 1997, Dalgas et al. 2010, Lincoln et al. 2011, Gordon et al. 2018) and increasing life satisfaction (Katula, Rejeski & Marsh 2008) and self-rated health (Heiestad et al. 2016).

Well-being might also be enhanced indirectly through more stable dispositional traits. Of these traits, the present research focused on sense of coherence Well-being might also be enhanced indirectly through more stable dispositional traits. Of these traits, the present research focused on sense of coherence. According to the salutogenic model, physical activity is one of the

generalized resistance resources that contribute to SoC (Antonovsky 1987, Read et al. 2005). It is possible, therefore, that LTPA as a throughput variable not only has direct effects on well-being (output variable) but may also be related to well-being through individual input variables, such as SoC. Thus far, however, an association between physical activity and SoC has only been found in cross-sectional studies (Hassmén, Koivula & Uutela 2000, Read et al. 2005). The effect of RT on sense of coherence has thus far been investigated in only a couple of studies: a 12-week RT program among older hip-fracture patients (Pakkala et al. 2012) and a 24-week RT program among older women (Ericson et al. 2018). In both studies, no intervention effect on sense of coherence was found.

Continuance of training post intervention

After an organized intervention has ended, many participants do not continue training independently. For example, Geirsdottir et al. (2015) and Inaba et al. (2008) found that 42-43% of participants reported continued RT. In turn, Van Roie et al. (2015) found that only 20% of participants continued RT during a four-month follow-up when the information about continuation was provided by a fitness center. Although even a single training session has shown a temporary positive effect on well-being (Levinger et al. 2009, Elkington et al. 2017), to obtain long-standing improvements in well-being regular and repeated training is needed. Previous studies have shown that the improvements gained during RT interventions diminish, at least in part, after the intervention if the RT is not continued (Inaba et al. 2008, de Backer et al. 2008, Steele et al. 2017).

Again, only a few studies have investigated factors related to the continuance of training post intervention. A couple of studies have investigated the role of self-efficacy in continuance of RT after an intervention and found inconsistent results. Neupert, Lachman and Whitbourne (2009) found that those with higher self-efficacy were more likely to continue RT during the six-month follow-up after a six-month video-guided RT intervention with elastic bands, whereas Van Roie et al. (2015) found that neither self-efficacy nor motivation predicted continuance of RT six months after a three-month supervised intervention. As continuance post intervention is required to maintain the improvements in both well-being and muscles gained during the intervention, more information is needed about the factors related to RT continuance.

2.3.4 Mediators and moderators of the relationship between leisure activities and well-being

Mediators between leisure activities and well-being

The psychological reasons why leisure activities contribute to well-being are summed up in the DRAMMA model by Newman, Tay and Diener (2014). The model postulates five different ways in which leisure activities can enhance well-being: through detachment-recovery, autonomy, mastery, meaning and affiliation. The DRAMMA model combines elements of many different theories: for example, affiliation, autonomy and mastery are closely related to the self-

determination theory (Ryan & Deci 2000b) and detachment-relaxation, mastery and autonomy to the theory of recovery experiences proposed by Sonnentag and Fritz (2007).

The detachment-recovery effect of leisure is important, especially for the working-age population and is two-fold. First, recovery can occur when skills and resources that are strained at work are no longer loaded (Meijman & Mulder 1998). Second, psychological detachment from work, i.e., detaching one's thoughts from work-related issues, is important (Sonnentag & Fritz 2007). To achieve the detachment-recovery effect, leisure activities should be sufficiently different from work tasks. Since the proportion of sedentary office work and cognitively demanding expert work has increased over the past few decades (Thorp et al. 2011), LTPA plays an important role as a counterbalance to work. For example, LTPA is a more effective way to decrease work-related fatigue than social and low-effort tasks (e.g., listening to music) (Rook & Zijlstra 2006). In addition to work, other aspects of life may benefit from detachment (Newman, Tay & Diener 2014).

In the self-determination theory, autonomy is a central need that leads to intrinsic motivation and overall well-being (Ryan & Deci 2000b). In the context of leisure, intrinsic motivation towards leisure activities may lead to better well-being. Mastery experiences are gained from activities that challenge the individual and give the experience of success (Newman, Tay & Diener 2014). In the best case, mastery experiences are connected to a state of flow, which is reached when an individual is conducting an enjoyable, sufficiently challenging task (Csikszentmihalyi 1993). Mastery experiences are also an important resource for feelings of self-efficacy (Bandura 1994). In addition to personal success, self-efficacy can be developed by observing the success of other people, especially those who are considered role models and those who are similar to ourselves (e.g., age peers) (Bandura 1994). Sonnentag and Fritz (2007) found that experiences of psychological detachment, relaxation, mastery and control in leisure time correlate positively with life satisfaction and negatively with health complaints and depressive symptoms.

Meaning in the DRAMMA model indicates that leisure activities can bring something of significance and value to people's lives (Newman, Tay & Diener 2014). This is important, especially for older adults, as in older age it might not be possible to participate in the same range of activities as earlier in life; hence, participation has to be optimized and focused on the most meaningful activities (Carstensen 1992, Carstensen, Isaacowitz & Charles 1999). As a social phenomenon, affiliation is related to leisure activities: participating in social activities helps to satisfy the need of social affiliation and relatedness (Newman, Tay & Diener 2014). The social aspect also plays an important role between LTPA and well-being: for example, Takeda et al. (2015) found that LTPA was only associated with better mental well-being when it involved other people. Similarly, Damush and Damush (1999) found that RT with elastic bands twice a week for eight months did not improve QoL in middle-aged and older women compared to a social waiting list control group. Those in the control group

participated in the same training sessions as those in the intervention group but without training: they acted as a repetition calculator for their pairs in the intervention group. The reason for the lack of an intervention effect may have been that both groups received the same social benefits from the intervention (Damush & Damush 1999).

Besides different psychological mechanisms, LTPA may be related to well-being through the physical benefits gained. Especially at an older age, sufficient levels of muscle strength and physical functioning are needed to perform many activities of daily living. Both muscle strength and functional capacity correlate positively with HrQoL at an older age (Samuel et al. 2012). In addition, several intervention studies have shown that improvements in strength and functional capacity during an intervention are associated with improvements in well-being (Netz et al. 2005, Geirsdottir et al. 2015, Haraldstad et al. 2017). However, the correlations between physical and psychological improvements reported in these studies have usually been relatively small ($r<.30$), suggesting that the positive effect of exercise on well-being is not exclusively explained by physical factors. The present study only included these physical benefits as potential mediators.

Moderators of the relationship between leisure activities and well-being

The relationship between leisure and well-being is likely to vary between different groups. Previous studies have shown that life situation, gender and age may moderate this relationship. With respect to life situation, positive associations between leisure engagement and well-being seem to be stronger among retired than working adults (Kuykendall, Tay & Ng 2015). In terms of gender, previous studies suggest that the associations between LTPA and well-being may be stronger among women than among men (Wang et al. 2011, Wolf & Wohlfart 2014). Men and women also differ in their LTPA behavior: in Finland, for example, women met the physical activity guidelines for aerobic activity more often than men while men met the guidelines for strength training guidelines more often than women (Bennie et al. 2017). Hence, it is possible that some types of LTPA are important for men and other types are important for women. Men and women may also have different reasons for participating in LTPA, as autonomous motivation is positively related to exercise participation in women but not in men whereas controlled motivation is positively related to exercise participation in men but not in women (Weman-Josefsson, Lindwall & Ivarsson 2015). Previous studies have also shown that in different age groups of men and women (Brajša-Žganec, Merkaš & Šverko 2011) and in rural compared to urban older adults (Sewo Sampaio, Ito & Sampaio 2013) well-being is related to different leisure activities.

In the case of exercise interventions, some meta-analyses have investigated whether specific characteristics of interventions modify their effects on well-being. The length of the intervention, duration of training sessions and training frequency (sessions per week) are the most commonly investigated characteristics. The results have been inconsistent: for example,

shorter RT sessions (<45 min) were more beneficial in decreasing depressive symptoms (Gordon et al. 2018) whereas longer (>45 min) exercise sessions improved mood more than shorter ones (Arent, Landers & Etnier 2000). The results for intervention length are also similarly inconsistent. Two meta-analyses have suggested that shorter exercise interventions (<12 weeks) are more effective for mood and overall well-being than longer ones (>12 weeks) (Arent, Landers & Etnier 2000, Netz et al. 2005). For depressive symptoms, no differences were observed between interventions under and over 12 weeks (Gordon et al. 2018) whereas in a review study interventions under 12 weeks were more beneficial for well-being (McAuley & Rudolp 1995). It is possible that the effects of interventions on psychological functioning follow a curvilinear growth pattern, with most improvements occurring at the beginning of the intervention (McAuley 1999).

The role of training frequency is also unclear. In general, the training frequency in RCTs has been two or three times a week. In the meta-analysis by Arent, Landers and Etnier (2000), training less than three times a week was more effective in improving mood in older adults than training three or more times a week. In contrast, the meta-analysis by Netz et al. (2005) found an association between a higher frequency and improvements in some indicators (e.g., self-efficacy), although frequency was not significant for most of the indicators studied. Gordon et al. (2018) also found that all RT interventions, whether with two, three or four or more sessions per week, had an effect on depressive symptoms. Similarly, comparisons of RCTs with RT frequencies have not found differences in effects: all frequencies from two to four times a week have been beneficial for psychological functioning (Benton & Schlairet 2012, Ramirez-Campillo et al. 2016) (Benton, Ramirez-Campillo 2016). However, it remains unclear whether training less than the recommended twice weekly is sufficient to improve psychological functioning.

Compared to the above-mentioned characteristics of interventions, it has consistently been found that exercise interventions improve well-being in all age groups and among both sexes (McAuley & Rudolp 1995, Netz et al. 2005, Rhyner & Watts 2016, Gordon et al. 2018). There is also some evidence that the positive effects of exercise interventions are greatest for individuals who show the lowest baseline activity (Netz et al. 2005) and that interventions are more beneficial for those who have diagnosed depression compared to others (Rhyner & Watts 2016, Gordon et al. 2018).

3 PURPOSE OF THE STUDY

The purpose of this study was to investigate the associations between leisure time activities and well-being in midlife and older age with special focus on leisure time physical activity and resistance training. The research questions were:

1. How are leisure activities linked to well-being in 50- to 74-year-olds? (Study I + unpublished results)

2. Do cross-sectional and longitudinal associations exist between leisure time physical activity and well-being in midlife? (Study II)

3. Does resistance training with different frequencies have an effect on well-being and exercise-related motivational and volitional characteristics? (Study III + IV)

4. Do well-being or exercise-related motivational and volitional characteristics predict the continuance of resistance training? (Study IV + unpublished results)

The analytical framework of the study is presented in Figure 3. The associations between leisure activities and well-being were investigated with cross-sectional, longitudinal and experimental designs. Leisure activities were explored through participation in various leisure activities and more specifically through different types of physical activities. Particular attention was paid to resistance training as a subtype of leisure time physical activity.

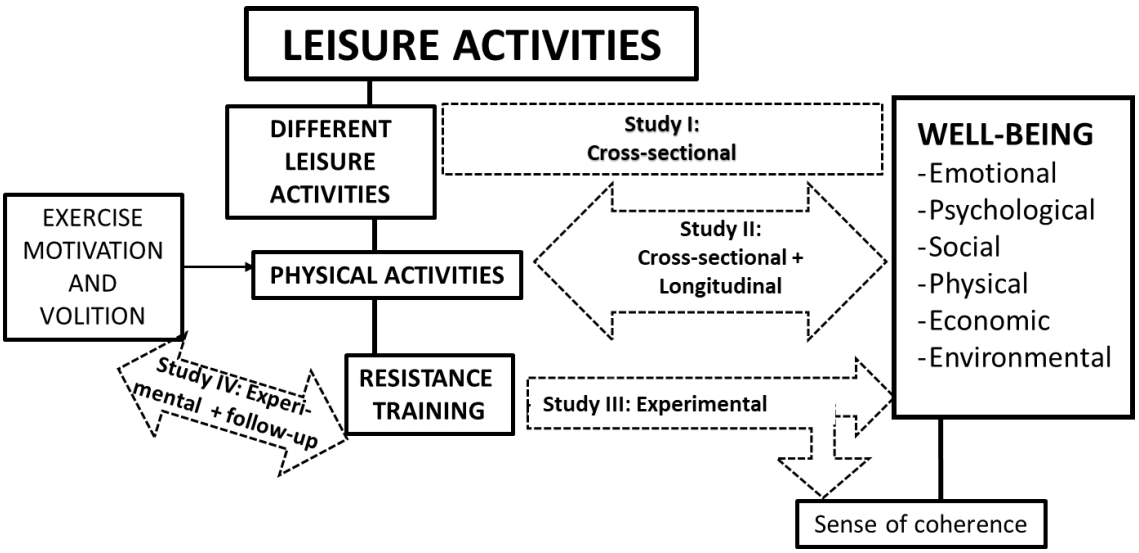

FIGURE 3 The analytical framework of the study.

4 MATERIALS AND METHODS

4.1 Study design and participants

Data from three larger research projects were utilized in this study: the Finland 2014 - Consumption and Lifestyle study (Study I), the Jyväskylä Longitudinal Study of Personality and Social Development (JYLS) (Study II) and the Minimum Resistance Training Frequency: effect on motivation and adherence to train, overall health status and neuromuscular performance -study (MRTF) (Studies III and IV). The datasets, designs and numbers of participants are summarized in Table 1.

TABLE 1 Datasets, designs and participants in the different studies.

Study	Dataset	Design	n	Age, years (mean±sd)
I	Finland 2014	**Observational** Cross-sectional	1351 women and men 760 women and men	18-74 (50.0±16.3) 50-74 (62.2±6.5)
II + Unp.	JYLS	**Observational** Longitudinal	285 women and men 271 women and men	42 50
III, IV + Unp.	MRTF	**Experimental** 9-month intervention 12-month follow-up	104 women and men: 81 in intervention groups 23 in control group	65-75 (68.5±2.8)

Unp. = Unpublished results

4.1.1 Finland 2014 – Consumption and Lifestyle study (Study I)

Data for the Finland 2014 study was gathered by a postal survey designed to investigate the consumer habits and lifestyle of the adult population in Finland (Koivula, Räsänen & Sarpila 2015). Similar surveys were conducted in 1999, 2004 and 2009. For this research, only data from the 2014 survey were used.

The target sample in 2014 was 3 000 adults aged 18-74 selected by random sampling from the Finnish Population Register Database (Koivula, Räsänen & Sarpila 2015). People living in institutions and those whose mother tongue was other than Finnish were excluded. The questionnaire was sent to 2 971 adults in August 2014 and returned by 1 351, and thus the response rate was 45%. The final sample was made nationally representative by applying correction coefficients for gender and age (Koivula, Räsänen & Sarpila 2015).

4.1.2 Jyväskylä Longitudinal Study of Personality and Social Development (Study II)

The JYLS is an ongoing longitudinal study in which the same participants have been followed from age 8 to 50 at six- to eight-year intervals (Pulkkinen 2017). The study was initiated by Professor Lea Pulkkinen in 1968 with a sample of 12 randomly selected complete second-grade classes from schools in Jyväskylä, Finland (173 girls and 196 boys, N=369) (Pulkkinen 2017). Most of the participants were born in 1959.

In this study, data collected at ages 42 and 50 were utilized. The data were collected by mailed life-situation questionnaires, semi-structured interviews including inventories, medical examinations and laboratory tests (Pulkkinen 2017). In this study, individuals who had participated in at least one data collection phase (at age 42 or 50) and in at least one data collection method were included in the analyses (n=303, 82% of the initial sample). Those who participated at age 42 (n=285, 77%) and 50 (271, 73%) were representative of the initial sample in childhood socio-emotional behavior and school achievement (Metsäpelto et al. 2010, Pulkkinen & Kokko 2012, Pulkkinen 2017). They were also representative of their Finnish age-cohort born in 1959, for example, in marital status and employment (Metsäpelto et al. 2010, Pulkkinen & Kokko 2012, Pulkkinen 2017).

4.1.3 Minimum Resistance Training Frequency: effect on motivation and adherence to train, overall health status and neuromuscular performance study (Studies III and IV)

MRTF study was an RCT investigating the effects of different RT frequencies on maximal muscle strength and functional capacity among older adults aged 64-75 (trial register number: NCT02413112) (Walker et al. 2017, Turpela et al. 2017, Fernandez-Lezaun et al. 2017). Sample size was determined by a pre-trial power analysis for primary outcomes based on the effect sizes reported in the meta-analysis by Liu and Latham (2009). To achieve a probability of 80% of observing a treatment difference at a significance level of 0.05, a sample size of 60 for muscle strength and 88 for functional capacity was calculated sufficient.

The recruitment process and study flow are shown in Figure 4. Two thousand invitation letters were sent to a random sample of older adults aged 65 to 75 living in the Jyväskylä area and selected from the Population Register Center of Finland. Of them, 23% responded by completing an online

questionnaire assessing their eligibility to participate. Inclusion criteria were 1) no previous RT background, 2) aerobic exercise less than 3 hours/week (i.e., not meeting the current physical activity recommendations), 3) body mass index below 37, 4) no previous testosterone-altering treatment, 5) no serious cardiovascular disease or lower-limb injuries that could affect the ability to perform training or testing, 6) no medication related to the neuromuscular or endocrine systems, 7) ability to walk without walking aids and 8) no current smoking (Walker et al. 2017). Those who met the inclusion criteria (n=148) were invited to an information session, where they were informed about the study design and potential risks. Those who signed a written informed consent (n = 116) underwent examination by a physician. Finally, 108 were accepted to perform vigorous RT.

After discarding two dropouts, 106 participants were randomized into one of three RT frequency groups performing RT one (RT1), two (RT2) or three (RT3) times a week or a non-training control group (CG). Two CG participants dropped out immediately after randomization owing to the randomization result. Consequently, they did not answer the baseline questionnaires on the variables used in studies III and IV, and thus the final sample size for these analyses was 104. The 9-month RT intervention was implemented from March to December 2015. Measurements were conducted at baseline (pre-intervention) and at months 3 and 9 (post-intervention). Follow-up face-to-face interviews were conducted with the training group participants in June 2016 at six months post intervention and by phone in December 2016 at 12 months post intervention. One CG participant dropped out before the month 3 post measurements and four participants between the month 3 and month 9 measurements (one each from RT1 and RT2 and two from CG). The dropouts (n=5) did not differ in any demographic characteristics from those who remained in the study but had statistically significant lower baseline values in psychological and social QoL: for psychological QoL the means ±sd of independent samples Mann-Whitney U-test were 13.8±2.28 for dropouts vs. 16.03±1.93 for completers (p=.036) and for social QoL 12.00±2.74 for dropouts vs. 15.27±2.37 (p=.015) for completers.

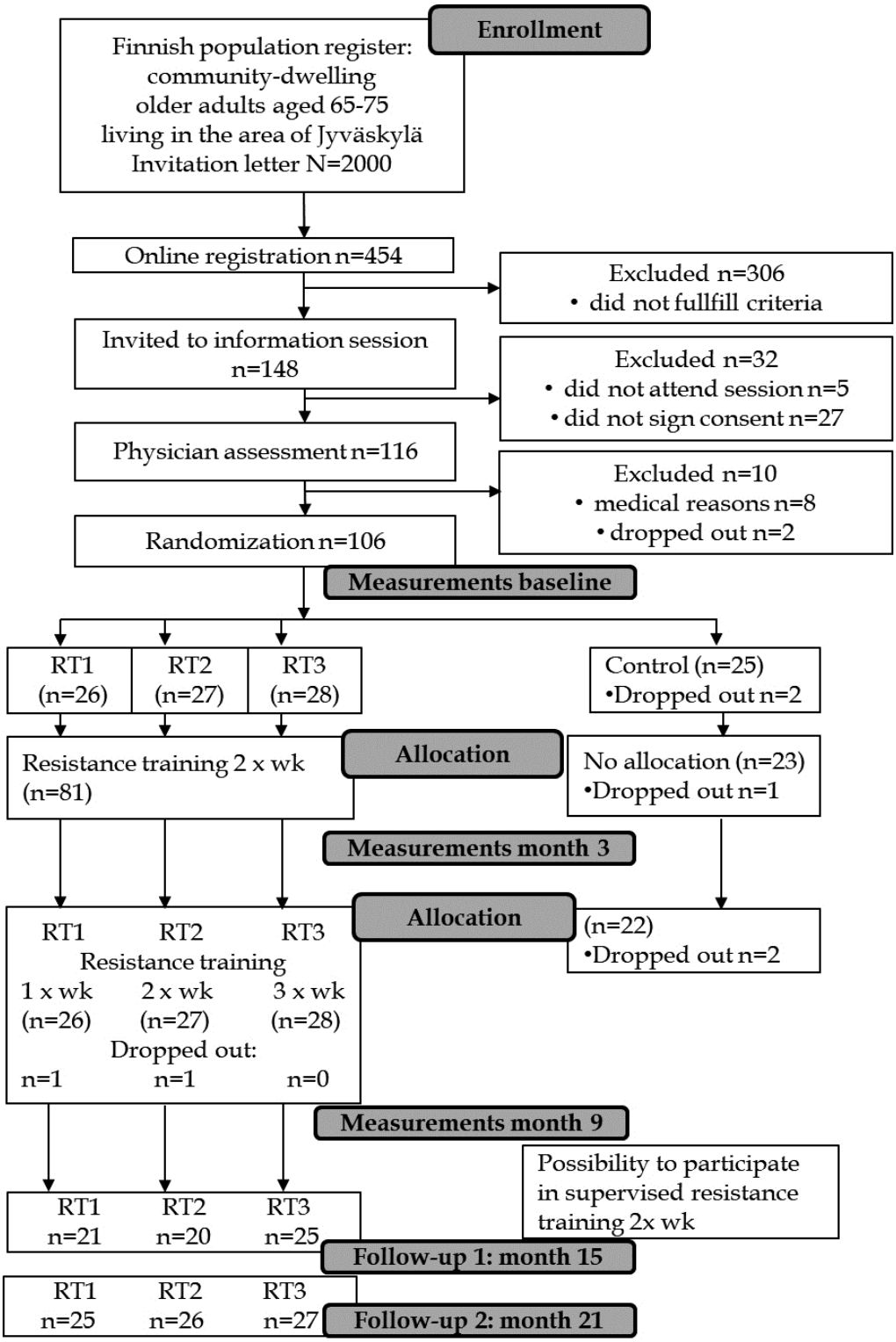

FIGURE 4 Flow of the Minimum Resistance Training Frequency study.

4.2 Ethics

The Finland 2014, JYLS and MRTF studies were all conducted according to good scientific practice. As the Finland 2014 is a postal survey, participants received information about ethical issues and the use of data in a cover letter. The Ethical Committee of the Central Finland Health Care District approved the JYLS data collection in 2001 and again in 2009 when the health examinations were conducted. The University of Jyväskylä Ethical Committee approved the MRTF data collection. In the MRTF study, participants were informed about the study design and examined by a physician before signing the written informed consent. In all three studies, participation was voluntary and participants had the right to withdraw from the study at any stage.

In all projects and phases of the research, the privacy and security of the data were ensured. The data analyzed for this dissertation were anonymous and stored on the JYU server behind a password. The Finland 2014 data are stored in the Faculty of Social Sciences at the University of Turku and in the Department of Social Sciences and Philosophy at the University of Jyväskylä. All the data used in the analyses were anonymized. The data remain available for research, teaching and study in the Finnish Social Science Data Archive (FSD) for five years following their collection. The FSD is a certificated repository and fulfills the requirements imposed by the The EU General Data Protection Regulation (GDPR) (2016/679). All the JYLS data files are stored on the JYU server behind passwords and in the FSD repository. Permission for data use has to be applied for by contacting the study´s principal investigator and requires a relevant research plan. During the analysis phase in the MRTF study, data were stored on the university server and accessible to the researchers behind university passwords. After the study, all data are stored without personal identifications on DVDs in a secure place at the Biology of Physical Activity unit in the Faculty of Sport and Health Sciences, University of Jyväskylä.

4.3 Measurements

The measurements used in this study are summarized in Table 2.

4.3.1 Well-being

In each study, self-ratings were used to measure the different dimensions of well-being. In the Finland 2014 study (Study I), emotional, physical and economic dimensions of well-being were measured. Emotional well-being was self-rated with the questions “How happy are you in general?” and “How satisfied are you with your life at present?” on a scale from 1 = very happy/satisfied to 5 = very unhappy/dissatisfied. Physical well-being was

TABLE 2 Summary of the study variables.

Variables	Study	Methods and references
Self-reported leisure activities		
Consumption of goods and services	I	Questionnaire
Frequency of participation in leisure time physical activity	II	Single question
Frequency of participation in different physical activities	II	Questionnaire
Aerobic exercise min/week	III, IV	Diaries
Continuance of resistance training	IV	Interviews
Well-being		
Happiness	I, II	Self-report, single question (Study II) (Perho & Korhonen 1993)
Life satisfaction	I, II	Self-report, single question (Study I) and question related to different domains of life (Study II) (Pulkkinen, Feldt & Kokko 2005)
Positive Mood	II	Brief Mood Introspection Scale (Mayer & Gaschke 1988, Feldman 1995)
Social well-being	II	Scales of Social Well-Being (Keyes 1998)
Psychological well-being	II	Scales of Psychological Well-being (Ryff 1989)
Self-rated health	I, II	Self-report, single question
Psychosomatic symptoms	II	Health Symptom Checklist (Aro, Paronen & Aro 1987)
Financial situation	I	Self-report, single question
Occupational/social status	I	Self-report, single question
Quality of life	III	WHOQOL-Bref (World Health Organization 1998)
Depressive symptoms	III	Beck Depression Inventory II (BDI-II) (Beck, Steer & Brown 1996)
Sense of coherence	III	SOC-13 (Antonovsky 1987)
Exercise-related motivational characteristics		
Motivation styles for physical activity	IV	RM4-FM (Deci & Ryan 2004)
Motivation styles for training	IV	RM4-FM (Deci & Ryan 2004)
Exercise self-efficacy	IV	10-item questionnaire (Schwarzer & Renner 2000, Schwarzer & Renner 2009)
Action and coping planning	IV	8-item questionnaire (Sniehotta, Scholz & Schwarzer 2006)
Socio-demographic indicators		
Age	I-IV	
Gender	I-IV	
Marital status	I-IV	
Education	I-IV	
Income	I	
Employment status	I	
Residential area	I	

assessed by self-rated health with the question "How would you describe your health in general?" on a scale from 1 = very good to 5 = very bad. Because only 1.7% of participants selected option 5, it was combined with option 4. Economic well-being was assessed with questions about satisfaction with financial situation and occupational/social status. The response scale was from 1 = very good to 5 = very bad. All the scales for emotional, physical and economic well-being were reverse-scored, with higher values representing better well-being.

In the JYLS (Study II), well-being was measured by mental (including emotional, psychological and social well-being) and physical well-being at ages 42 and 50. The dimensions of emotional well-being assessed were happiness, life satisfaction, positive mood and negative mood (Kokko et al. 2013, Kokko, Rantanen & Pulkkinen 2015). Happiness was measured with a single self-rated question: "How happy or satisfied have you been at different stages of your life?" (Perho & Korhonen 1993). The response scale was from -3 = very unhappy or dissatisfied to 3 = very happy or satisfied. Life satisfaction was the mean value of satisfaction in seven different life domains (housing, financial situation, choice of occupation, present occupational situation, leisure, present intimate relationship or lack of it and present friendly relations) measured on a scale from 1 = very unsatisfied to 4 = very satisfied (Pulkkinen, Feldt & Kokko 2005). Positive and negative mood were assessed with the Brief Mood Introspection Scale (Mayer & Gaschke 1988, Feldman 1995). Positive mood was the mean value of two items ("Happy" and "Satisfied") and negative mood the mean value of five items (e.g. "Frightened") (Kokkonen 2001). The response scale was from 1 = describes my mood not at all to 4 = describes my mood very well. The values for happiness, life satisfaction, positive mood and negative mood (reversed) were standardized and their mean value calculated to represent emotional well-being. Psychological well-being was measured with the shortened, 18-item Scales of Psychological Well-being (Ryff 1989) and social well-being with the 15-item Scales of Social Well-Being (Keyes 1998). The response scale in both scales was from 1 = strongly disagree to 4 = strongly agree and mean scores were calculated. Psychological well-being and social well-being were combined with emotional well-being to form a latent variable for mental well-being.

In the JYLS, physical well-being was measured with self-rated health and psychosomatic symptoms (Kinnunen et al. 2005, Kinnunen et al. 2012). Self-rated health was asked with the single question "What has your state of health been like during the past year?" on a scale from 1 = excellent to 5 = extremely poor. Because less than one percent of participants selected option 5 at both ages, it was merged with option 4 (= fairly poor). Psychosomatic symptoms were measured as the mean value of 19 symptoms drawn from the Health Symptom Checklist (Aro, Paronen & Aro 1987). Participants reported how frequently they had experienced the symptoms listed (e.g., headache, stomach ache) during the last six months on a scale from 1 = never to 4 = very often. Both the self-rated health and psychosomatic symptoms scales were reverse-scored, with higher values representing better self-rated health and lower

frequency of psychosomatic symptoms and combined to form a physical well-being latent variable.

In the MRTF study (Study III), the WHOQOL-Bref questionnaire was used to assess the physical, psychological, social and environmental domains of QoL (World Health Organization 1998). The raw domain scores were transformed to a scale of 4-24. To assess well-being more broadly, sense of coherence and depressive symptoms were also measured. Antonovsky´s 13-item SOC-13 scale was used to measure sense of coherence (Antonovsky 1987, Eriksson, M. & Lindström 2005). The response scale was from 1 to 7, and the mean score of the scale was calculated. Depressive symptoms were measured with the Beck Depression Inventory II (BDI-II), which is a revised version of the original BDI (Beck, Steer & Brown 1996). The inventory includes 21 statements about different depressive symptoms. The overall scoring range is from 0 to 63 where a higher value indicates more depressive symptoms. 13 is the threshold for mild depression.

4.3.2 Leisure activities and leisure time physical activity

Leisure activities were measured in the Finland 2014 study by the consumption of 15 different goods and services. Participants were asked to evaluate how much they spend on different goods and services compared to the "average consumer". The response scale was from 1 = much more to 5 = much less, and for the analyses it was reversed. In the JYLS, leisure activities at age 50 were measured as frequency of participation in different leisure activities, including different types of physical activities. The response scale was from not at all or very seldom (=1) to twice weekly or more frequently (=4). In addition, frequency of participation in exercise (including incidental exercise) or sports in leisure time was asked at ages 42 and 50 with a response scale from never (=0) to practically every day (=6).

At the MRTF baseline (Studies III and IV), participants were asked about their leisure time engagement in aerobic exercise with a single question. This information was used to exclude from the study those who already met the physical activity guidelines (aerobic exercise >180 min/week). During the intervention, all physical activity outside supervised RT was tracked by physical activity diaries (Waller et al. 2013). The average weekly amount (minutes/week) of leisure time aerobic exercise was calculated from the diaries for month 1-3 and 4-9. Participants were asked in structured interviews at six and twelve months after the intervention whether they had continued with RT (Study IV). If yes, they were asked to state the regularity and average weekly frequency of their RT.

4.3.3 Exercise-related motivational and volitional characteristics

Exercise-related motivational and volitional characteristics were measured in the MRTF study (Study IV) and included measures of motivation, self-efficacy and planning related to physical activity, exercise and training. Motivation was

measured with two Exercise Self-Regulation Questionnaires (RM4-FM). One questionnaire assessed motivation for physical activity in general and the other motivation for training/working out. Each motivation style (external, introjected, identified and intrinsic motivation) was measured with four items in the physical activity questionnaire (total 16 items) and with three items in the training questionnaire (total 12 items). The response scale was from 1 = not at all true to 7 = very true and the mean score for each motivation style was calculated separately for physical activity and training.

A 10-item scale measured exercise self-efficacy (Schwarzer & Renner 2000, Kangasniemi et al. 2015). Five items assessed how confident participants were in their ability to maintain exercise behavior in different situations (Schwarzer & Renner 2000) and five items asked about common barriers to engaging in exercise (Schwarzer & Renner 2009). Answers were given on a scale from 1 = very certain I cannot to 4 = very certain I can, and the mean score for exercise self-efficacy was calculated.

Action and coping plans for exercise were assessed with a 10-item scale. Participants were asked whether they had detailed plans about when, where, how and how often to exercise (action plans) and how to confront obstacles, setbacks and difficult situations and when to pay extra attention to prevent lapses (coping planning) (Sniehotta et al. 2005).

4.3.4 Other variables

Social-demographic indicators included age, gender, marital status and education (Studies I-IV), and income, employment status and residential area (Study I). All these were collected with a questionnaire.

4.4 Resistance training intervention

In the MRTF study (Studies III and IV), the participants randomized into the intervention groups (RT1, RT2 and RT3, n=81) participated in supervised RT for nine months. The RT sessions were performed in the University of Jyväskylä gym in small groups.

During the first three months of the intervention, all the intervention groups participated in RT twice a week on non-consecutive days. The purpose was to familiarize the participants with RT techniques and build their capacity for subsequent high-load training. The focus was on muscle endurance using low loads. The three-month period was divided into a four-week initiation phase and an eight-week super-set phase (Walker et al. 2017).

For the next six months, the training frequency in RT1 was decreased to once a week, in RT2 it remained unchanged (twice a week) and in RT3 it was increased to three times a week. All the intervention groups received the same two-session training program; thus, to complete the program RT1 required two weeks, RT2 required one week and RT3 completed three programs in two

weeks. The focus during the six-month period was on maximum strength and muscle mass. During weeks 1-12 and 13-20, the focus was on maximum strength and muscle mass using progressive loads. Every fourth week was treated as a recovery week with reduced training intensity. During the last four weeks (21-24), the focus was on explosive strength (Turpela et al. 2017, Fernandez-Lezaun et al. 2017).

The non-training control group was instructed to maintain their normal lifestyle throughout the intervention period. After the post-intervention measurement, the controls were given the opportunity to participate in supervised RT twice a week for six months.

4.5 Statistical analyses

All statistical analyses, except for the structural equation modelling (SEM) used in Study II, were performed using the Statistical Package for Social Sciences (SPSS) versions 22.0-24.0. SEM analyses were performed using Mplus (Muthén & Muthén 2017). A significance level of $p<.05$ was used in all analyses.

4.5.1 Descriptive statistical analyses

Descriptive statistics for the study variables were reported as means and standard deviations for continuous variables and as frequency percentages for categorical variables. Independent samples t-tests or ANOVA were used to analyze the differences between independent groups for continuous variables and chi square-tests for categorical variables. Differences within the same group between different measurement points were analyzed by paired samples t-tests. Spearman rank-order correlation and Pearson correlation tests were used to investigate associations between different variables and Fisher´s (1915) r-to-z transformation (z-test) to investigate differences in correlations between age groups.

4.5.2 Dimension reduction of leisure activities

To reduce their numbers for the main analyses, leisure activities were grouped into categories. In Study I, factor analysis was used to group the fifteen leisure consumption variables from the Finland 2014 dataset. Because these variables were not normally distributed, factors were extracted using principal axis factoring. In addition, because it was reasonable to assume that combinations of leisure activities differ between people, the oblique rotation method of direct oblimin, where factors are allowed to correlate with each other, was used (Fabrigar & Wegener 2012). The factor analysis revealed four factors with Eigenvalues >1: technology, indulgence, appearance and literature & culture. Travel, exercise and health care were treated as single variables as they did not load sufficiently (factor loading <0.4) on any specific factor. Cronbach´s alphas

for the factors were calculated and, given the small number of variables per factor (2-4), found to be satisfactory (>.60).

The JYLS data on leisure activities and different types of LTPA did not give clear factor solutions. In addition, it cannot be presumed that an individual who participates in one creative activity (e.g. painting) also participates in all the other creative activities. Therefore, leisure activities (unpublished results) and LTPA (Study II) were categorized to represent the types of leisure activities or physical activities most commonly studied in the literature (Rodríguez, Látková & Sun 2008, Brown, MacDonald & Mitchell 2015, Pagán 2015). Leisure activities were thus categorized into 1) physical exercise (e.g. walking, running, and skiing), 2) cultural events (e.g. going to the theater and concerts), 3) creative activities (e.g. writing, singing, playing an instrument and handicraft), 4) reading (reading newspapers, magazines, non-fiction and fiction) and 5) TV and computer (watching TV and videos, surfing the internet, using social media). In Study II, to capture the multiple sides of LTPA, leisure activities were categorized into five groups: 1) walking (walking 3-4 kms, walking 5 kms or more and Nordic walking), 2) endurance training (running, skiing, swimming and cycling) 3) group and team sports (ball games and group fitness), 4) gym training (a single question) and 5) rambling in nature (a single question). These five types of LTPA were intended to capture both less intense (walking) and vigorous endurance training and resistance training (gym training). Group and team sports and rambling in nature were included in the analyses to take the social side of LTPA and connectedness with nature into account.

4.5.3 Regression analyses

Linear regression models were used for continuous outcomes and ordinal regression models for categorical outcomes. Fulfilment of the key assumptions of regression analysis (in linear regression multivariate normality, homoscedasticity, absence of auto-correlation and multicollinearity and a linear relationship; and in ordinal regression proportional odds and absence of multicollinearity (Chatterjee & Simonoff 2013)) was ascertained before embarking on the analysis proper.

Analyses were controlled for gender, education, income and age in Study I and for education and marital status in Study II. Categorical variables comprising at least five categories (education, travel, exercise and health care in Study I) were used as continuous variables in the analyses (Hagger-Johnson 2014).

In Studies I and II, possible moderators between leisure activities or LTPA and well-being were investigated using regression models. In Study I, these were age, marital status, employment status and residential area, and in Study II gender. These possible moderators were binary coded and continuous leisure activity variables were standardized before calculating the interaction terms.

4.5.4 Structural equation modelling

Structural equation modelling (SEM) was used in Study II to investigate the longitudinal associations between LTPA and well-being. Mplus (Muthén & Muthén 2017) with the maximum likelihood with robust standard error and scale-corrected chi-square value (MRL) estimator was used in the SEM analyses. The analyses were based on covariance matrices. The cross-lagged path model was chosen as it allows study of the direction of the associations between the variables over time (Selig & Little 2012, Kearney 2017).

The SEM analyses were performed in four steps. First, the key assumption of the cross-lagged path model, i.e., longitudinal measurement invariance in mental well-being and subjective health, was analyzed. Second, multigroup modelling was used to analyze whether these longitudinal measurement models were similar between men and women. Third, a full longitudinal model with mental well-being/subjective health at ages 42 and 50 and LTPA at ages 42 and 50 was analyzed. Fourth, multigroup modelling was used again to investigate whether the paths for men and women were similar. Model fit was evaluated by the chi-square test ($p<.05$ indicates an acceptable fit), comparative fit index (CFI; values >.95 indicate acceptable fit and values >.97 good fit), root mean square error of approximation (RMSEA; values between .05 and .08 indicate adequate fit and values <.05 good fit) and standardized root mean square residual (SRMR; values of ≤.08 indicate an acceptable fit) (Schermelleh-Engel, Moosbrugger & Müller 2003, Schreiber et al. 2006, Hooper, Coughlan & Mullen 2008).

4.5.5 Intervention effects

In the MRTF study, the intervention effects (Studies III and IV) were, with the exception of two participants, who dropped out from the control group right after randomization and did not participate in baseline (or any) measurements for variables used in studies III and IV, analyzed according to the intention-to-treat principle.

The generalized estimation equation (GEE) method with an unstructured working correlation matrix was used to analyze intervention effects. The GEE method is an extension of the generalized linear model and assumes that cases are dependent within subjects and independent between subjects (Ma, Mazumdar & Memtsoudis 2012). The GEE method takes within-subject correlation into account in repeated measurements (Zhang, Cao & Ahn 2014). Because the groups did not differ in any of the demographic variables (e.g. gender, education, age) at baseline, the GEE analyses were not adjusted for these. Instead, the GEE analyses were adjusted for the amount of leisure time aerobic exercise (min/week), as it was not stable in all groups during the nine-month intervention period. The average weekly amounts (min/week±sd) of aerobic exercise at baseline, months 1-3 and months 4-9 were 110.0±62.7, 201.6± 97.7 and 171.8± 86.2 in CG; 113.0±63.6, 125.1±114.0 and 125.6±24.7 in RT1; 110.8±56.1, 128.8± 101.3 and 133.4±136.6 in RT2; and 84.6±58.3, 145.0±101.4 and

112.3±109.2 in RT3. RT3 showed higher weekly amounts at months 1-3 compared to baseline values (paired samples t-test t=-2.98 (df=23), p=.007) and CG at months 1-3 (t=-2.53 (df=11), p=.028) and months 4-9 (t=-2.23 (df=18), p=.039). The GEE results with and without aerobic exercise were relatively identical, hence only the adjusted results are presented.

In addition to the GEE method, the differences between groups were assessed by effect sizes. Mean changes for each group were calculated by subtracting the prior value (baseline or month-3) from the later value (month-3 or month-9) and effect sizes were calculated using the Cohen´s d formula (Cohen 1992). Effect sizes over 0.2 are considered small, over 0.5 medium and over 0.8 large (Cohen 1992, Sullivan & Feinn 2012).

4.5.6 Missing data

In the Finland 2014 dataset (Study I), the amount of missing data for single questions was minor (Koivula, Räsänen & Sarpila 2015). For the variables used in this study, the proportion of missing values was, with the exception of the control variable income where 17% of values were missing, under 3%. Little's MCAR test (p>.05) showed that the missing values were missing completely at random; hence pairwise deletion was used in the analyses.

In the JYLS dataset (Study II) both longitudinal and cross-sectional values were missing: longitudinally, some participants participated in only one of the two measurements times and cross-sectionally some participants participated in only some of the data collection methods (life situation questionnaire, interviews, medical examination). Full information maximum likelihood (FIML) estimation, in which missing data are assumed to be missing at random, and which utilizes all the available data, was used in the analyses (Muthén & Muthén 2017).

In the MRTF study (Studies III and IV) missing values in outcomes were due to dropout. Intervention effects were analyzed by the GEE method, which also utilizes information from incomplete pairs. In addition, the GEE analyses were adjusted for the amount of leisure time aerobic exercise. This information was collected from the physical activity diaries where data for months 0-3 were observed to be missing for 19 participants (18%), 11 of whom were in the control group (missing data rate in control group 48%). Therefore, the missing data were imputed using linear regression imputation. Aerobic exercise at baseline and at months 4-9 were used as predictors. Imputation was performed for the seven participants who had both values. After imputation, the proportion of missing values in the leisure time aerobic exercise variable was under 10% in each group.

5 RESULTS

5.1 Participant characteristics

Table 3 summarizes the characteristics of the 1 200 middle-aged or older adult participants from the Finland 2014, JYLS and MRTF studies whose data were used in this dissertation research.

TABLE 3 Characteristics of the participants from the Finland 2014, Jyväskylä Longitudinal Study of Personality and Social Development (JYLS) and Minimum Resistance Training Frequency (MRTF) studies used in this dissertation research.

	Finland 2014 (n=760)	JYLS[a] (n=303)	MRTF[b] (n=104)
	%	%	%
Women	55.5	46.1	54.8
Education			
Basic education	22.9	19.4	33.3
Upper secondary education	24.6	30.4	30.4
Tertiary education	52.4	50.2	36.3
Marital status			
Married/ cohabiting	73.1	78.0	77.7
Single/divorced/widowed	26.9	22.0	22.3
Working status			-
Employed	39.3	73.4	
Unemployed/other	6.1	25.4	
Retired	54.5	1.3	
Age (years, mean±sd)	62.2±6.5	42 and 50	68.5±2.8

[a]Education, marital status and working status from age 42, [b]Baseline characteristics

5.2 Leisure activities, leisure time physical activity and well-being

5.2.1 Cross-sectional associations between leisure activities, leisure time physical activity and well-being

The most common leisure activities reported by the participants in 2009 at age 50 were watching TV, reading newspapers and magazines, walking, gardening and cycling (unpublished results). In the category of physical activities, the highest frequencies of participation were for walking, cycling and rambling in nature (Study II). Participants aged 50-74 showed the highest expenditure on health care, exercise and travel (Study I).

The cross-sectional associations between leisure activities and well-being from two different datasets were regression-analyzed (Studies I and II + unpublished results). The results are shown in Table 4. Among older adults aged 50 to 74, higher expenditure on travel was associated with better economic, emotional and physical well-being whereas higher expenditure on health care was associated with lower emotional and physical well-being. Expenditure on literature and culture was positively associated with economic well-being, appearance with emotional well-being and exercise with physical well-being. Similarly, higher frequency of participation in exercise was associated with better physical well-being at age 50. Participation in creative activities was positively associated with emotional well-being, and reading with both social and psychological well-being.

5.2.2 Moderators of the associations between leisure activities and well-being

The possible moderating effects of age, gender, employment status and marital status in Study I and gender in Study II were investigated by adding interaction terms to the regression analysis. In Study I, six statistically significant interaction effects were found (Figure 5). First, higher expenditure on indulgence and appearance were associated with better emotional well-being among the older adults (aged 50-74) but not among the younger ones (aged 18-49). Second, positive associations were observed between expenditure on literature & culture and emotional well-being and between expenditure on travelling and physical well-being among the older middle-agers (aged 50-61) but not young-olds (aged 62-74). Third, low expenditure on exercise was associated with lower economic well-being among the retired but not among the employed older adults and with lower self-rated health among those living without a partner compared to those living with a partner. In Study II, gender had two statistically significant interaction effect: positive association of rambling in nature with emotional well-being as well as with physical well-being at age 50 were found, but only among men (Figure 6).

TABLE 4 Linear regression analyses on measurements of well-being (WB) of older adults aged 50-74 (Model A, n=760) and middle-aged adults aged 50 (Model B and C, n=209). Standardized β-coefficient presented.

	Economic WB	Emotional WB	Physical WB[a]	Social WB	Psychological WB
Model A (Finland 2014)					
Technology	-.04	-.07	.92		
Indulgence	.07	.03	1.16		
Literature & culture	.11*	.05	.99		
Appearance	.06	.11*	1.33		
Exercise	.05	.06	1.53**		
Travel	.16**	.12*	1.20*		
Health care	-.04	-.10*	.46**		
Adj. R^2	.31	.10	.23		
Model B (JYLS)					
Exercise		.06	.23**	.04	.00
Cultural events		-.00	-.06	-.04	-.03
Creative activities		.15*	.09	.07	.05
Reading		.13	.05	.25**	.23**
TV and computer		-.04	-.00	-.09	.00
Adj. R^2		.15	.16	.15	.19
Model C (JYLS)					
Walking		.14	.08	.10	.35**
Endurance training		.18	.32**	-.04	.01
Group & team sports		.18	.06	-.02	-.11
Gym training[b]		.01	.07	-.07	-.07
Rambling in nature[b]		-.15	-.17	.24*	.14
Gender		-1.21**	-.51	.32	-.29
Gender*walking		-.20	.13	.25	-.57
Gender*endurance training		-.46	-.52	-.10	-.07
Gender*group & team sports		-.44	-.08	.09	.16
Gender*gym training		.07	-.04	.09	.09
Gender*rambling in nature		.35**	.25*	-.08	-.17
Adj. R^2		.09	.11	.12	.14

[a]Model A for physical well-being analyzed with ordinal regression, odds ratios presented and Nagelkerke R^2. [b]Categorical variable, categories 0=not at all or very seldom, 1=1x/month-4x/month, 2=≥2x/wk.*p<.05, **p<.01. Model A adjusted for age, gender, education and income, Models B and C adjusted for education, marital status and gender. For Models C, interaction effects were first tested with models including only gender, activity and the interaction term between them; only statistically significant interactions were included in these models.

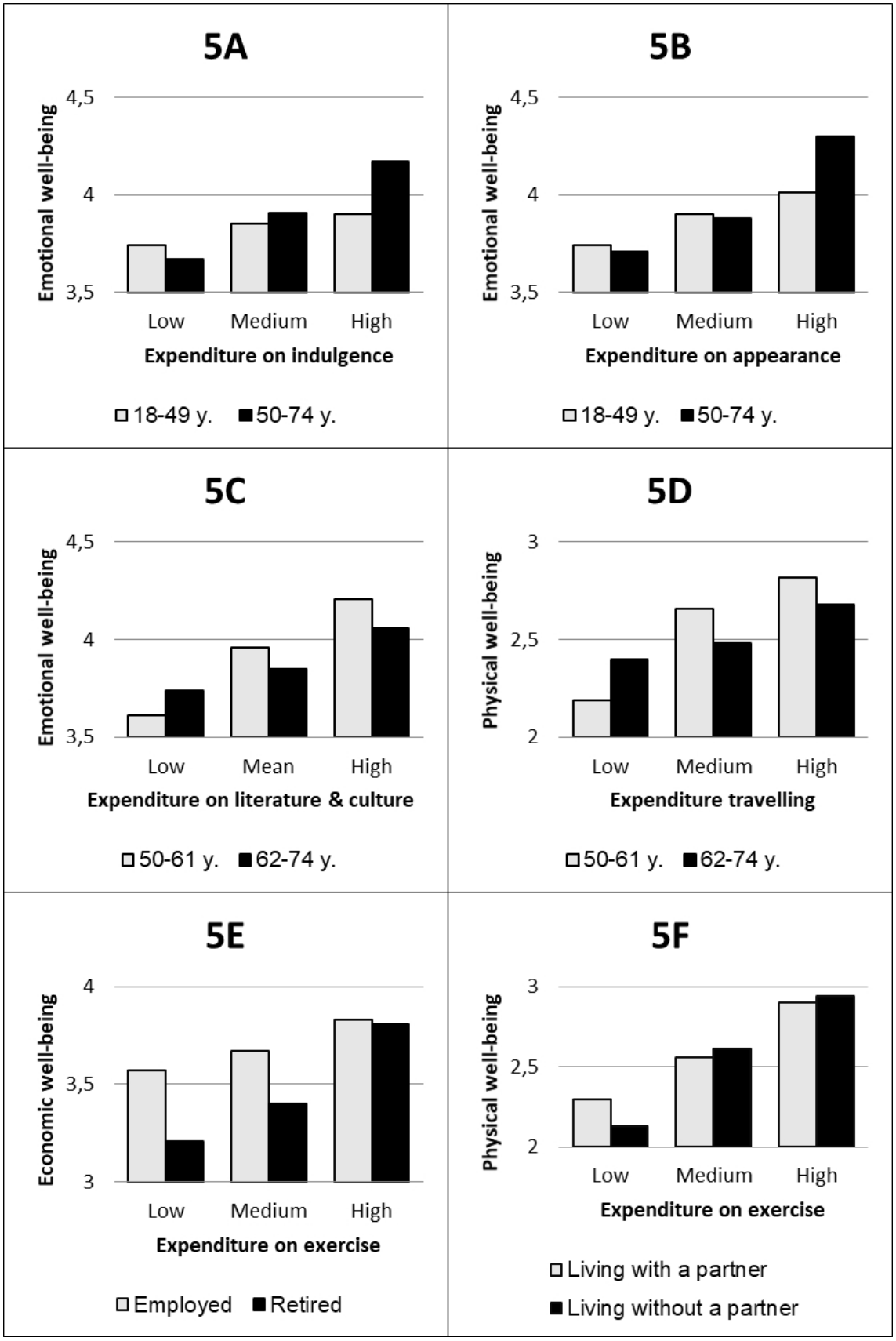

FIGURE 5 Interaction effects between leisure consumption and age or life situation on well-being scores. Figures 5A-5B n=1307; Figures 5C-5F include only older adults aged 50-74, n=737-742.

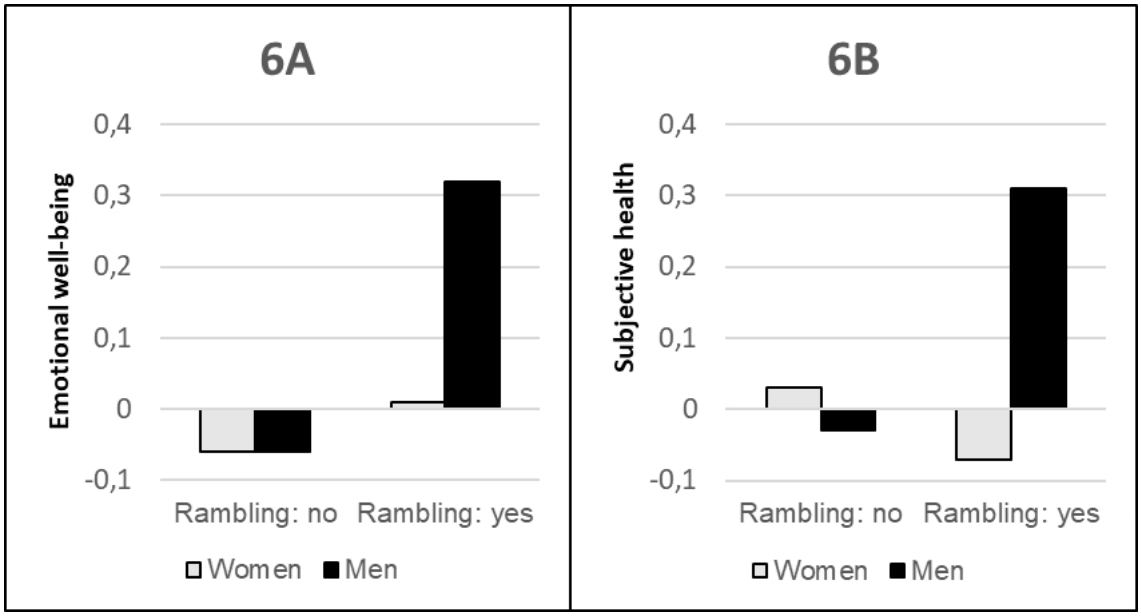

FIGURE 6 Interaction effect between participation in rambling in nature and gender on standardized emotional well-being (6A) and physical well-being (6B) scores.

5.2.3 Longitudinal associations between leisure time physical activity and well-being

The longitudinal associations between LTPA and well-being were investigated in Study II. Based on the measurement invariance analyses, factor loadings and error variances were set equal between the two time points (age 42 and 50) in both the mental well-being and subjective health models, and in the subjective health models intercepts were also set equal. Multigroup modelling did not show any gender differences in the longitudinal structure of mental well-being or subjective health.

The results obtained from the longitudinal models are presented in Figures 7 and 8. Mental well-being, subjective health and LTPA showed stability from age 42 to 50. The only longitudinal association observed between LTPA and well-being was that mental well-being at age 42 predicted LTPA at age 50. The multigroup analysis indicated no significant gender differences. The results shown in Figures 7 and 8 are therefore presented for the whole sample, i.e., men and women combined.

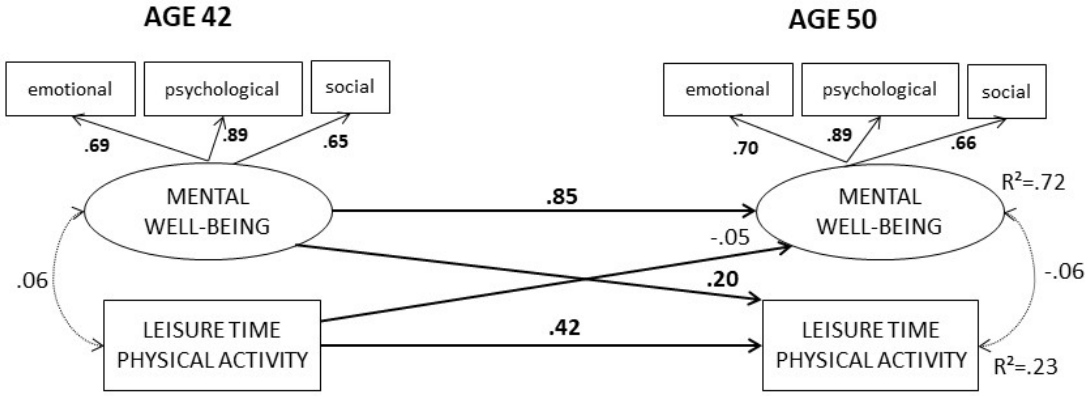

FIGURE 7 Longitudinal associations between leisure time physical activity and mental well-being. Structural equation model with standardized regression coefficients. Statistically significant (p<.05) coefficients bolded. For ease of reading, error terms are not shown. Model fit: x^2=28.949 (df=19), p=.067; CFI=.984; RMSEA [90% CI] =0.042 [0.000, 0.071], SRMR=0.044.

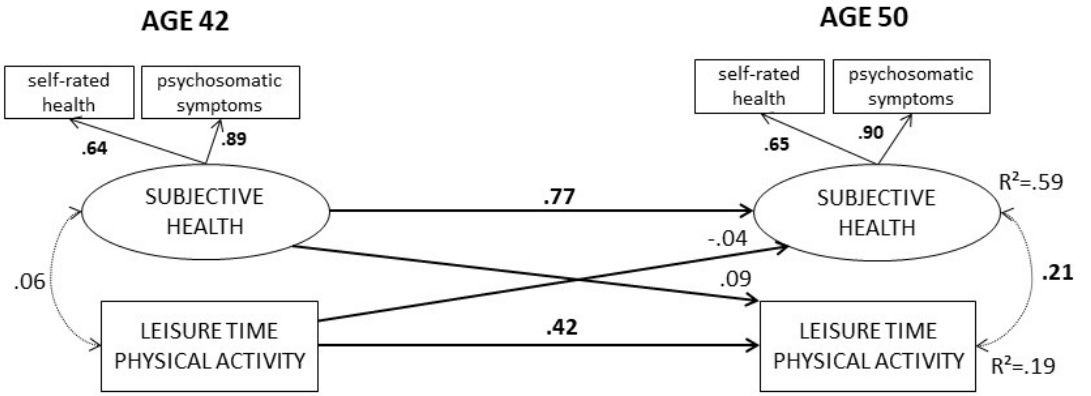

FIGURE 8 Longitudinal associations between leisure time physical activity and subjective health. Structural equation model with standardized regression coefficients. Statistically significant (p<.05) coefficients bolded. For ease of reading, error terms are not shown. Model fit: x^2=11.190 (df=9), p=.263; CFI=.993; RMSEA [90% CI] =0.028 [0.000, 0.074], SRMR=0.065.

5.3 Resistance training, well-being and exercise-related motivational and volitional characteristics

5.3.1 Effects of the resistance training intervention on well-being and exercise-related motivational and volitional characteristics

In the MRTF study, the participants in the three training groups (RT1, RT2 and RT3) and control group (CG) were comparable to each other in their baseline sociodemographic variables, physical activity levels, body mass index and

outcomes. The only exception was coping planning, which was higher in RT1 (mean±sd 11.0±2.7) compared to RT3 (8.9±2.7) (ANOVA F(df)=3.30(3), p=.024).

During the first three months of the intervention, one CG participant dropped out. The target adherence level of 90% was not reached by nine participants in the training group (their mean value was 87%) (Walker et al. 2017). During months 4-9, one RT1, one RT2 and two CG participants dropped out. Six participants did not reach the target training adherence level of 90%, although in all six cases adherence was over 75%.

At month 3 of the intervention, a positive intervention effect (group x time p<.05) was seen in environmental QoL, action and coping planning, self-efficacy and intrinsic motivation for training (Table 5). During months 4-9, when the training groups were training at different frequencies, the only difference between the three groups was in environmental QoL, which decreased in RT1 compared to RT2 and RT3 (Table 5).

TABLE 5 Effects of the resistance training intervention on psychological characteristics, analyzed by generalized estimated equations (GEE); p-values presented.

	Model for months 0-3			Model for months 4-9			Model for months 0-9		
	Group	Time	Group × time	Group	Time	Group × time	Group	Time	Group × time
Physical QoL	.570	.087	.064	.276	.662	.828	.291	.323	.685
Psychological QoL	.262	**<.001**	.814	.439	.832	.421	.161	**<.001**	.521
Social QoL	.543	.276	.722	.886	.080	.493	.520	**.004**	.740
Environmental QoL	.578	.308	**.048**	.076	.469	**.025**[a]	.260	.228	**.011**[b]
Sense of coherence	.241	**.002**	.110	.057	.178	.550	.222	**<.001**	**.032**[c]
Depressive symptoms	.722	**<.001**	.840	.912	.348	.429	.979	**<.001**	.201
Self-efficacy	.246	.325	**<.001**	.234	**.004**	.136	.934	.094	.265
Action planning	.208	.956	**.006**	.253	.336	.678	.775	.086	**<.001**[d]
Coping planning	.305	.367	**.010**	.167	**.041**	.397	**.045**	.358	**.012**[e]
PA:External	.755	.247	.283	.721	.569	.174	.356	.070	.136
PA:Introjected	.462	.652	.296	.753	.170	.203	.691	.239	**.025**[f]
PA:Identified	.200	.118	.133	.823	.614	.381	.593	**.026**	.087
PA:Intrinsic	.546	.691	.255	.885	.096	.100	.960	**.042**	**.030**[g]
TR:External	.860	**.008**	.125	.829	.479	.139	.647	**.002**	.380
TR:Introjected	.986	.753	.379	.816	.276	.069	.928	**.003**	.998
TR:Identified	.457	.115	.064	.829	.741	.464	.714	.071	.281
TR:Intrinsic	.467	.106	**.007**	.541	.930	.215	.891	**.045**	**<.001**[h]

Models adjusted for leisure time aerobic physical activity. Significant group×time differences between [a]RT1 and RT2 (p=0.005), RT1 and RT3 (p=0.036); [b] RT2 and CG (p=.001), RT2 and RT1 (p=.047), RT2 and RT3 (p=.043); [c] RT2 and CG (p=.006), RT2 and RT3 (p=.017); [d] RT1 and CG (p=.019), RT2 and CG (p<.001), RT3 and CG (p<.001); [e] RT2 and CG (p=.010), RT3 and CG (p=.001); [f] RT2 and CG (p=.026); [g] RT2 and CG (p=.013), RT3 and CG (p.009); [h] RT2 and CG (p=.008), RT3 and CG (p<.001). RT1-3=Resistance training 1,2 or 3 times/week gtoups, CG=Control group. QoL = Quality of life, PA = Motivation styles for physical activity, TR = motivation styles for training.

When the month 9 results were compared to the baseline values (Table 5), the nine-month intervention had induced positive effects on environmental QoL, sense of coherence, action and coping planning, introjected regulation for physical activity and intrinsic motivation for both physical activity and training. These results showed some differences between the groups: RT1 improved only

in action planning compared to the control group (CG), whereas RT3 improved in action and coping planning and intrinsic motivation for physical activity and training compared to CG and in intrinsic motivation for training compared to CG and RT1. RT2 improved in action and coping planning and intrinsic motivation for physical activity compared to CG, introjected motivation for physical activity and intrinsic motivation for training compared to CG and RT1, sense of coherence compared to RT3 and CG, and environmental QoL compared to RT1, RT3 and CG.

The correlations between the changes in strength, functional capacity, well-being indicators (Study III) and motivational and volitional characteristics (not published) are shown in Table 6. The change in maximum strength correlated positively with changes in action and coping planning as well as with changes in identified and intrinsic motivation for both physical activity and training. The change in functional capacity correlated positively with the change in external regulation for physical activity.

TABLE 6 Pearson´s correlation coefficients between intervention-induced changes in strength (S), functional capacity (FC) and psychological characteristics.

Change in	Physical QoL	Psychological QoL	Social QoL	Environmental QoL	Sense of coherence	Depressive symptoms	Self-efficacy	Action planning	Coping planning	PA:External	PA:Introjected	PA:Identified	PA:Intrinsic	TR:External	TR:Introjected	TR:Identified	TR:Intrinsic
S	.04	.10	.07	.16	.05	-.10	.09	.36	.29	.16	.20	.22	.28	.09	.07	.24	.37
FC	-.07	-.08	.01	.00	-.06	.09	.12	.03	.13	.30	.02	.05	.06	-.09	.16	-.02	.19

r ≥.22 p<.05; r≥.28 p<.01; r=.37 p<.001. QoL = Quality of life, PA = Motivation styles for physical activity, TR = motivation styles for training.

The possible mediator effect of improvements in strength and functional capacity for changes in psychological characteristics was analyzed by adjusting the GEE models for changes in strength and functional capacity (not published). This supplementary analysis was performed for the psychological characteristics in which a significant intervention effect was found, i.e., action and coping planning, self-efficacy, intrinsic motivation for physical activity and training, introjected regulation for physical activity, environmental QoL and sense of coherence. The results of the adjusted analyses are shown in Table 7. As can be seen when comparing Table 7 to Table 5, adjusting the analysis for changes in strength and functional capacity removed the significance of some of the intervention effects (group x time). However, in those models neither change in strength nor change in functional capacity was significantly related to outcome; hence the mediator hypothesis was not supported.

TABLE 7 Effect of the intervention on selected variables; models adjusted for changes in strength (S) and functional capacity (FC). Analyzed by generalized estimated equations (GEE); p-values presented.

	Self-efficacy	Action planning	Coping planning	Intr. motiv. for Tr	Environmental QoL	Intr. motiv. for PA	Introj. reg. for PA	SoC
Models for months 0-3								
Group	.244	.995	.858	.906	.834			
Time	.608	**.024**	.711	.928	.831			
Group x time	**.001**	**.017**	**.018**	**.029**	.213			
S change	.601	.264	.429	.208	.542			
FC change	.095	**.025**	**.027**	**.003**	.719			
Models for months 0-9								
Group		.605	**.012**	.851	.171	.931	.762	.251
Time		**<.001**	**.001**	.735	.414	.866	.454	<.001
Group x time		**<.001**	**.032**	**.005**	**.040**	.052	.087	.144
S change		.812	.980	.920	.305	.837	.272	.541
FC change		.622	.382	.883	.065	.317	.858	.491

Intr. mot.=Intrinsic motivation, Tr=Training, QoL= Quality of life, PA=Physical activity, Introj. reg. = Introjected regulation, SoC=Sense of coherence

5.3.2 Predictors of resistance training continuance

Continuance of RT up to one year after the end of the supervised intervention was based on self-reports obtained in the interviews conducted at six and twelve months after the intervention. RT continuance included both independent continuance of RT and supervised continuance in groups. Fifty-four percent of the participants (n=42) were classified as non-continuers, 22% (n=17) as once-a-week continuers and 24% (n=19) as twice-a-week continuers. These three groups did not differ in gender (x^2=3.1, df=2, p=.216) or training group during the intervention (x^2=4.1, df=4, p=.282).

Differences between the groups in post-intervention measured level and intervention-induces change in motivational and volitional characteristics (Study IV) and well-being indicators (not published) were investigated. Only two differences were observed between groups in all these characteristics: the twice-a-week continuers showed higher intervention-induced change in exercise self-efficacy (mean change 1.5±3.4 vs. -1.1±3.3, ANOVA p=.021) and intrinsic motivation related to training (0.9±0.6 vs. 0.1±1.0, ANOVA p=.002) compared to non-continuers. The change in intrinsic motivation for training was also significant when compared to that of the once-a-week continuers (0.9±0.6 vs. 0.2±1.0, ANOVA p=.002). The relative changes in key variables are presented in Figure 9.

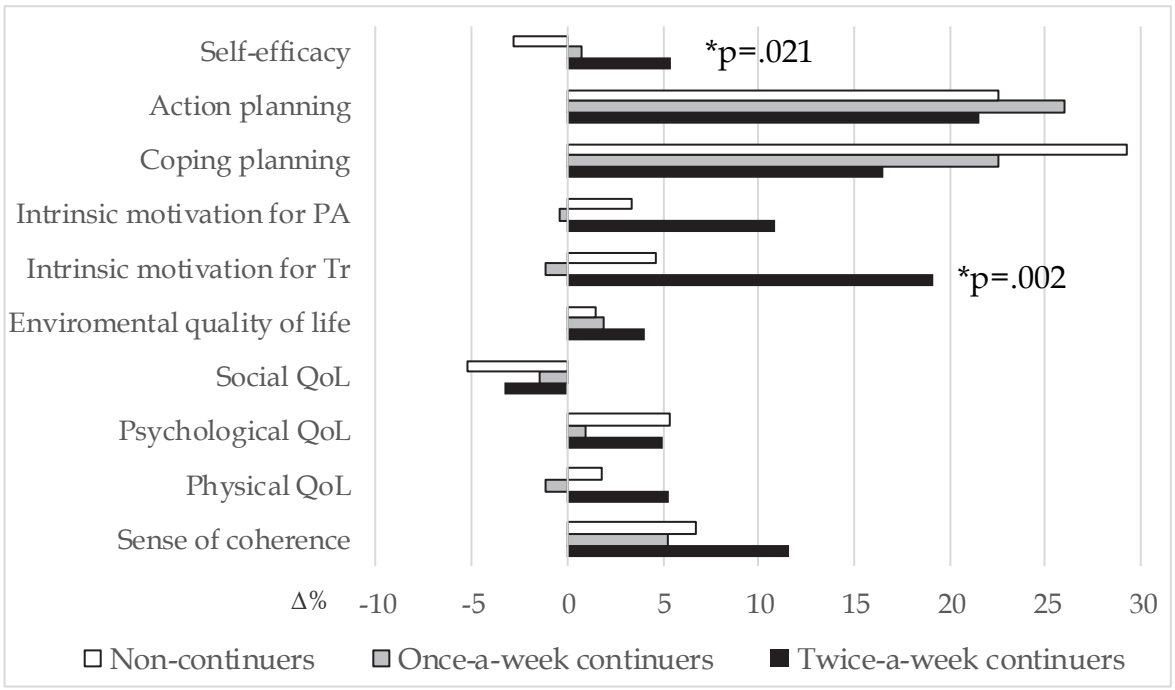

FIGURE 9 The relative change induced by the resistance training intervention in selected psychological characteristics between the non-, once-a-week- and twice-a-week continuers. PA=Physical Activity, Tr=Training, QoL=Quality of Life. *Significant difference between groups analyzed by ANOVA.

6 DISCUSSION

This research investigated the associations between leisure activities, especially LTPA, and well-being among middle-aged and older adults. The results showed that, when analyzed cross-sectionally, different leisure activities and different types of LTPA were positively associated with different dimensions of well-being. However, LTPA did not predict later well-being in midlife; instead, mental well-being predicted participation in LTPA. The RT intervention had positive effects on well-being and on motivational and volitional characteristics related to exercise. The increase in positive motivational and volitional characteristics predicted continuance of RT after the intervention.

6.1 Cross-sectional associations

The positive associations between leisure activities and well-being found in the present cross-sectional research resembled those of previous studies (e.g. Brajša-Žganec, Merkaš & Šverko 2011, Pagán 2015, Schmiedeberg & Schröder 2017), suggesting that participation in activities requiring active involvement is related to better well-being. In the present study, these include activities such as travel, exercise and creative activities. Previous studies have even found negative associations between sedentary activities, such as watching TV, and well-being (Schmiedeberg & Schröder 2017). In the present study, sedentary activities, such as watching TV, computer use and expenditure on technology, showed no association at all with well-being. However, some sedentary activities, such as reading, may be active in a mental way. In the present study, reading was positively related to both psychological and social well-being.

Whereas leisure has often been investigated from the standpoint of participation in different leisure activities, the present results reveal the importance of also looking at well-being from other perspectives. Here, different activities were associated with different dimensions of well-being. Emotional well-being, measured by, e.g., life satisfaction and mood, represents the hedonic approach to well-being (Ryan & Deci 2001). The results of previous

studies investigating the associations between leisure activities and well-being have mostly been based on these measures. In the present research, expenditure on appearance, participating in creative activities and amon men also rambling in nature were all positively related to emotional well-being. These activities offering experiences of pleasure that contribute to better mood, happiness and satisfaction.

Psychological and social well-being reflect positive human functioning (Ryan & Deci 2001, Keyes 2005). In this research, positive associations were found between reading and both of these, between walking and psychological well-being and between rambling in nature and social well-being. These dimensions of well-being have been little studied in relation to leisure activities. As connectedness with nature has previously been associated with both psychological and social well-being (Howell et al. 2011), experiences of being outdoors and in nature are possible reasons for the associations found here between walking and psychological well-being and rambling in nature and social well-being. High psychological and social well-being are informative about an individual's flourishing in both personal and social life (Keyes 2005). Reading may also offer possibilities to both develop oneself and feel connected to the community.

In the present research, physical well-being reflected subjective health. In line with previous studies showing a positive association between exercise and self-rated health (Hassmén, Koivula & Uutela 2000, Södergren et al. 2008), expenditure on exercise was positively associated with physical well-being. Interestingly, of the different types of LTPA, endurance training was the only one to show a relationship with physical well-being at age 50 among both men and women, while rambling in nature was only important among men. The difference between men and women in the association of rambling in nature with emotional and physical well-being may be explained by the content of rambling in nature: among men, it correlated with other vigorous activities whereas among women it did not. Because most adults in midlife rate their health as relatively good (Andersen, Christensen & Frederiksen 2007, Kinnunen et al. 2012), it is possible that the role of physical activity for health is shown only for more vigorous activities, such as endurance training. Of the non-physical activities investigated in the present study, only travel was associated with physical well-being. In fact, it was positively related to physical, emotional and economic well-being. This supports previous findings of a positive association between travel and well-being (DeLeire & Kalil 2010, Pagán 2015, Schmiedeberg & Schröder 2017, Cho, Post & Kim 2018) and findings that investment in experiences rather than goods per se, is related to well-being (Van Boven & Gilovich 2003, Dunn, Gilbert & Wilson 2011).

Previous studies have shown that age, gender and life situation may moderate the associations between leisure activities and well-being (Wang et al. 2011, Brajša-Žganec, Merkaš & Šverko 2011, Wolf & Wohlfart 2014, Kuykendall, Tay & Ng 2015). The present results support the idea that age may moderate these associations, as some of the associations between leisure activities and

well-being were stronger among older adults (aged 50-74) than younger adults (aged 18-49), and again stronger among late middle-agers (aged 50-61) than young olds (aged 62 to 74). In contrast to previous findings (Wang et al. 2011, Kuykendall, Tay & Ng 2015), only single differences were found for employment or marital status: low expenditure on exercise was related to lower economic well-being among retired than employed adults and to lower physical well-being among adults living without a partner than those living with a partner. For gender, the present findings contradict those of previous studies according to which the associations between LTPA and well-being may be stronger among women than men (Wang et al. 2011, Wolf & Wohlfart 2014). It seems that the role of age, life situation and gender warrant further consideration in future studies.

Altogether, these results suggest that different types of activities are important for different dimensions of well-being and that age seems to moderate these associations. In future studies, the multidimensionality of well-being should be better taken into account.

6.2 Longitudinal associations

The present longitudinal results did not support previous findings that LTPA predicts well-being later in life (Blomstrand et al. 2009, Ku et al. 2014, Takeda et al. 2015, Ku, Fox & Chen 2016). This is somewhat surprising given that the follow-up time in the present study was eight years whereas in previous studies LTPA has predicted well-being as many as 24 years later (Blomstrand et al. 2009). The main reasons for this result could be the present participants' high stability of well-being and their age. First, both mental well-being and subjective health showed high stability from age 42 to 50. The stability of mental well-being has previously been shown for the same data between ages 36 and 42 (Kokko et al. 2013) and 42 and 50 (Kokko, Rantanen & Pulkkinen 2015). This high stability is in line with previous findings that mental well-being is predominantly explained by trait and autoregressive variance (Lucas & Donnellan 2007) and is closely related to personality traits (Kokko, Rantanen & Pulkkinen 2015). The presence of high stability may have left no room for LTPA to predict mental well-being or subjective health.

Second, individuals in midlife typically have busy lives with multiple responsibilities related to family, work and society (Lachman 2004, Lachman, Teshale & Agrigoroaei 2015). Therefore, the present eight-year period may have included many life changes and other issues that explain why LTPA did not predict later well-being. This explanation is supported by some previous studies in which LTPA predicted later well-being among older adults (Lee, C. & Russell 2003, Ku et al. 2014), and the finding that in midlife the relationship between LTPA and well-being was only cross-sectional (Xu, Anderson & Courtney 2010).

Instead of LTPA predicting well-being in midlife, this study revealed that those who had higher well-being at age 42 also participated in LTPA more often at age 50, even when previous participation in LTPA was taken into account. This association was similar for both men and women. Interestingly, only mental well-being showed this predictive value for LTPA; subjective health, in turn, showed no longitudinal association with LTPA. Although among middle-aged and older adults, the most common barrier to LTPA is lack of time, social or family activities are more common barriers in midlife than they are in older age (Justine et al. 2013). As both high mental and physical well-being are associated with a lower number of reported barriers to LTPA (McGuire, Seib & Anderson 2016), it is possible that those with better mental well-being perceive fewer barriers to LTPA and, despite other duties, simply put more effort into finding time for participation in LTPA. This finding supports the feedback-line in the system theory by Hagerty et al. (2001): well-being is not only an outcome of life choices but is also a resource for new choices. This is in line with previous findings that in midlife, people with at least relatively good mental well-being function well in other areas of life, such as work and social relations (Kokko & Feldt 2018). This role of well-being as a predictor of LTPA instead of its consequence is an under-researched topic that clearly merits further investigation.

6.3 Intervention effects

Previous RCTs investigating the effects of RT on well-being have found positive effects on the physical and mental/psychological dimensions of QoL or HrQoL (Ohira et al. 2006, de Vreede et al. 2007, Levinger et al. 2007, Dalgas et al. 2010, Wanderley et al. 2013, Ramirez-Campillo et al. 2014) and a decrease in depressive symptoms (Beniamini et al. 1997, Dalgas et al. 2010, Lincoln et al. 2011, Gordon et al. 2018) or no intervention effects on any dimensions of QoL or HrQoL at all (Damush & Damush 1999, Sillanpää et al. 2012, Bonganha et al. 2012, Ericson et al. 2018). The present results continue this inconsistent line: while no improvements were observed in physical (except for an almost statistically significant intervention effect after three months of the intervention), psychological or social QoL, the intervention had an effect on environmental QoL. The effects of RT on environmental QoL have been less studied as this dimension does not form part of the commonly used QoL/HrQoL questionnaires such as the RAND/SF-36. In the WHOQOL-Bref questionnaire used in the present study, environmental QoL includes questions, for example, about the home environment, physical safety and possibilities to access different services (World Health Organization 1998). This dimension may measure concepts partly similar to the physical dimensions used in other questionnaires and thereby reveal how improved functional capacity makes moving and living in one's home environment and neighborhood easier.

In addition to environmental QoL, the present study found a positive intervention effect on SoC. This is a novel finding, as previous studies have not found intervention effects on SoC (Pakkala et al. 2012, Ericson et al. 2018). It is possible that SoC, as a dispositional trait that usually shows high stability during the life course (Antonovsky 1987, McAdams 1995), needs more time to change. The length of the previous intervention studies were only three (Pakkala et al. 2012) and six months (Ericson et al. 2018), and in the present study an intervention effect was not seen until nine months of RT.

Besides environmental QoL and SoC, the results of this study suggest that a RT intervention can improve motivational and volitional characteristics related to training. The improvements in exercise self-efficacy and motivation found here are consistent with those reported in previous studies (Milne et al. 2008, Katula, Rejeski & Marsh 2008, LeCheminant et al. 2014, Heiestad et al. 2016). In addition to these, this study showed that a RT intervention could also improve action and coping planning related to exercise, a factor that has not previously been studied in relation to RT.

A possible reason for all the above-mentioned intervention effects are physical improvements gained during the intervention. In line with previous studies (Netz et al. 2005, Geirsdottir et al. 2015, Haraldstad et al. 2017), the changes in strength and functional capacity in the present study were positively related to some changes in psychological characteristics. However, the correlations were small and the physical changes did not remove the intervention effect on psychological characteristics. Therefore, it seems that physical reasons play only a minor role in psychological improvements gained from RT. In relation to intrinsic motivation, the self-determination theory (Ryan & Deci 2000b) suggests that autonomy, relatedness and competence lead to intrinsic motivation. The RT intervention included training in a small group and supervision and encouragement from research personnel, which may have contributed to the psychological improvements.

The possibility to compare different RT frequencies was a special feature of the MRTF study. In previous studies, all frequencies from two to four times a week have had positive effects on psychological characteristics (Benton & Schlairet 2012, Ramirez-Campillo et al. 2016). The results of the present study suggest that RT once a week may not be enough to exert a positive effect on psychological characteristics. For motivational and volitional characteristics, those who trained two or three times a week achieved more improvements than the once-a-week trainers. For environmental QoL and SoC, training twice a week was the best frequency. However, as all the training groups participated in RT twice a week during the first three months, and were then allotted different training frequencies, the results related to training frequency may also be revealing about change and continuity of training frequency than training frequency per se.

6.4 Continuance of resistance training

The positive effects of RT interventions on both physical and psychological characteristics do not persist, at least in their entirety, if participation in RT stops when the intervention stops (Inaba et al. 2008, de Backer et al. 2008, Englund et al. 2009, Steele et al. 2017, Fernandez-Lezaun et al. 2017). Therefore, it is also important to pay attention to the continuance of RT or other physical activities after the end of the supervised intervention. As the present intervention had positive effects on some motivational and volitional characteristics and as, above all, almost half of the participants in the intervention groups continued with regular RT for one year after the study, it seems that the intervention influenced some of the factors that turn intentions into behavior. It is suggested that interventions, including exercise classes, may promote the adoption of physical activity by rendering new behavior familiar and achievable (Knittle et al. 2018). In addition, interventions can change behavior in many different ways, such as influencing goals and planning, inducing behavioral comparison and offering social support (Michie et al. 2013). The intervention in the MRTF study may have included all these features even if the focus was not on behavior change.

In line with some previous findings (Neupert, Lachman & Whitbourne 2009, Teixeira et al. 2012, Rhodes et al. 2017), the present study found that exercise self-efficacy and intrinsic motivation were related to continuance of RT after the intervention. Interestingly, it was not their level that predicted continuance but the intervention-induced change. It is possible that many of the older adults who participated in the intervention already had sufficient levels of exercise self-efficacy and motivation to enroll in the study, as their average values were at the higher end of the scales (e.g., mean intrinsic motivation for physical activity of 5.7 on a scale from 1 to 7); however, those whose levels increased during the intervention found RT amenable and adopted it as a part of their life.

Importantly, improvements in exercise self-efficacy and intrinsic motivation led to the continuance of RT twice a week, whereas those who continued once a week did not differ in these values from non-continuers. It is possible that when the older adults noticed the benefits of RT after the nine-month intervention, some thought it worthwhile to continue with it on a once weekly basis, while only those who really enjoyed RT opted to continue twice a week. This is in line with previous suggestions that in addition to other contributory factors, such as ease of access to a gym, support from others and knowledge, those who gain satisfaction from a behavior are more likely to continue with it (Winett, Williams & Davy 2009). This is a topic that deserves further investigation as to reap physical benefits, a twice-weekly training frequency is superior to a once-a-week frequency (Ratamess et al. 2009).

6.5 Methodological considerations

Data drawn from three different sources — the Finland 2014, JYLS and MRTF datasets — were used in this study. The Finland 2014 study investigated a representative sample of the Finnish population, as the analyses were adjusted with corrective coefficients for age and gender (Koivula, Räsänen & Sarpila 2015). The JYLS initial sample contained 12 randomly selected classes from schools in Jyväskylä (Pulkkinen 2017). Those who participated in the data collection at age 42 and again at 50 did not differ from non-participants in childhood socioemotional behavior or school achievements (Metsäpelto et al. 2010, Pulkkinen & Kokko 2012, Pulkkinen 2017). In addition, the participants represented their Finnish age cohort in, e.g., marital status, employment and income (Metsäpelto et al. 2010, Pulkkinen & Kokko 2012, Pulkkinen 2017). In the MRTF study, invitation letters were sent to a random sample in the area of Jyväskylä (Walker et al. 2017). Only 23% of the target population responded. It is therefore possible that the responders already had a relatively high exercise motivation. However, the distribution of the participants' demographic data, such as educational level, marital status and body mass index, closely resembled that of the Finnish general population of the same age. Because the participants had to be capable of participating in both a progressive RT program for nine months and various physical measurements, the sample consisted of relatively healthy older adults aged 65 to 75. Therefore, the sample may not represent older adults with various diseases and functional limitations. However, the participants were not free of some common diseases, such as high blood pressure and type 2 diabetes. In sum, all three samples used in this dissertation research were well selected and representative.

Sample size in the JYLS and MRTF studies should be taken into account when interpreting the results. The JYLS sample size (n=303) was not sufficient to analyze moderator effects other than gender, and thus effects such as employment situation, existence of children or marital status were omitted as some groups would have been too small. In the MRTF study, the pre-trial power analysis was based on primary outcomes, i.e., maximum strength and functional capacity. It is possible that the sample size (n=104) was too small to reveal intervention effects on psychological outcomes. However, as statistically significant intervention effects were found for some outcomes, such as environmental QoL, SoC and intrinsic motivation, it seems that the sample size was also adequate for psychological outcomes.

A strength of the present study is the use of three different types of study design. The Finland 2014 study was a cross-sectional panel survey (Koivula, Räsänen & Sarpila 2015). Although these surveys have been conducted several times, the surveys were sent to a new sample at each data collection point and thus the same participants have not been followed. Therefore, it was not possible to analyze longitudinal associations and draw causal conclusions from

the data. Instead, the large sample of Finnish adults enabled comparisons of different age groups and individuals in different life situations.

In the JYLS, the same age-cohort representative participants have been followed since they were 8 years old (Pulkkinen 2017). The longitudinal design offered the possibility to use cross-lagged path analysis to investigate reciprocal relationships between LTPA and well-being across mid-adulthood, which is an under-researched area of life. Unfortunately, LTPA has not been measured consistently at the different data collection points, and therefore it was only possible to use information from ages 42 and 50 in the present study. In addition, questions about different types of LTPA were only asked at age 50, and hence it was possible to investigate only cross-sectional associations between different types of LTPA and well-being.

The MRTF RCT study offers the strongest information about causal relationships in the present research. The inclusion of a control group supports the conclusion that the changes observed were a result of this specific RT intervention. For ethical reasons the control group were given the possibility to participate in supervised RT after the post-intervention measurements. Hence, it was not possible to investigate whether the intervention effect on psychological outcomes continued to be present at the follow-up measurements six months after the intervention. Having three intervention groups engaging in RT at different frequencies per week enabled comparison of the intervention effects between groups. However, the study design also included a three-month familiarization period to build the participants' capacity for intensive RT. All three training groups trained at the same frequency for the first three months after which they were assigned to different frequencies during the final six months. It is not possible, therefore, to draw strong conclusions about the effects of different training frequencies on psychological outcomes.

The focus of the present research was on leisure activities, LTPA and well-being. It should be noted that in relation to all three datasets used (Finland 2014, JYLS and MRTF), this research was a secondary analysis. Taking into account that none of the datasets was optimal for the present focus, the measurements used worked well. A strength of this study is that in all sub-studies well-being was measured as a multidimensional construct. The importance of measuring well-being in multiple ways was also evident in the results, which suggest that the relationships of well-being with leisure activities, LTPA and RT were dissimilar between the different dimensions of well-being. In addition, most of the scales and questionnaires measuring well-being were internationally well known, highly used and validated.

Leisure activities were measured in the Finland 2014 study as consumption. It could be argued that the consumption of activities is dependent on financial resources, and does not necessarily reveal anything about activity participation rates. The association between consumption and participation frequency seems to be complicated: a study among a general sample of Spanish adults showed that while the consumption of sports correlates positively and moderately with participation frequency, among regular sport practitioners the

association is negative (Lera-López & Rapún-Gárate 2007). However, money could be seen as an investment resembling time, and the consumption of leisure services and products as reflecting personal values and lifestyle (Katz-Gerro 2004, Sassatelli 2007, Wheaton 2010). In addition, the results obtained from Study I suggest that the associations between well-being and leisure activities measured by consumption rates were very similar to those found in previous studies using different measurements of leisure activity (e.g., frequency or time spent on activities). Aside from how leisure activities or different types of LTPA are measured, the selection of activities included in a questionnaire also matters. It is possible that individuals participate in or consume activities other than those they are asked about. However, the attempt was made in the questionnaires to capture multiple types of activities and especially those that are common in Finland.

Physical activity has four qualities that should be taken into account when seeking to measure it: activity type, intensity, frequency and duration (Sylvia et al. 2014). In the present research, the ways of measuring LTPA were not optimal. In the JYLS, a single question on frequency of participation in LTPA generally was used in the longitudinal analysis. This question does not take into account different types of activities or their relative intensity or duration. In the JYLS cross-sectional analysis, frequencies of participation in different types of LTPA were used. These questions do not reveal the intensity or duration of participation. In addition, responses to frequency were limited to specific options: the most frequent option was "Twice a week or more frequently". This puts those who participate in activity twice weekly and those who do so every day in the same category. In the MRTF study, three types of measurements were used. First, self-reported weekly total time spent on aerobic activity, asked using a single question, was used as an inclusion criterion. Second, during the intervention period, physical activity diaries tracked daily physical activity, including information about all four factors: activity type, frequency, duration and intensity. Third, the continuance of RT after the intervention was elicited in follow-up interviews by questions about whether the participants had continued RT or not, and if yes, how many times per week on average. Unfortunately, no information about other physical activities engaged in during the follow-up was gathered, as participants often find keeping diaries rather burdensome. The use of single questions, as in the JYLS longitudinal study and in the MRTF study as inclusion criteria and as a way of evaluating continuance, is not the optimal way to measure physical activity, as it yields only limited information. However, when physical activity is measured in questionnaires covering a broader field, space for asking more detailed questions is not always available. However, even single questions can give a useful evaluation of LTPA (Portegijs et al. 2017). All the questions about physical activity were also based on self-reports. Self-reports are not as precise about all daily or leisure time activity as direct devices (e.g., accelometers) (Sylvia et al. 2014, Ndahimana & Kim 2017). However, as the focus in this study was on the associations between LTPA and subjective well-being, it was more important to obtain information

on general participation in LTPA and different types of LTPA than precise rates of energy expenditure.

The primary statistical analyses in the present study were regression analysis, SEM (cross-lagged path model) and the GEE method. The selection of statistical methods was based on the variables of interest and research questions. Regression analysis is a common way to study the relationship between multiple predictor variables (in this case, leisure activities in studies I and II and motivational and volitional characteristics in study IV) and the outcome variables (well-being in studies I and II, continuance of RT in study IV). SEM has some advantages over basic regression methods, such as the possibility to analyze multiple dependent and independent variables at the same time and to take measurement error into account (Cheng 2001). Criticism has been leveled at cross-lagged path models on the grounds that they do not evaluate within-individual change and therefore, in some cases, may even yield false results, such as indicating, in the case of two variables, that variable A is causally dominant, when in fact variable B is the dominant variable, or vice versa (Hamaker, Kuiper & Grasman 2015). To avoid this problem, at least three measurements points with a random intercept are required to control for within-person differences (Hamaker, Kuiper & Grasman 2015). In the present study, LTPA was measured identically at only two measurement points, and thus more sophisticated analyses were not possible. However, the cross-lagged path model is argued to be a useful method when the focus is on studying the relations between variables across time and not on change in variables (Selig & Little 2012). The GEE method was chosen to investigate intervention effects as it offers some advantages over the more traditional statistical methods (e.g. repeated measures ANOVA), including utilizing the information from incomplete pairs, allowing the inclusion of participants with an outcome value from at least one measurement point (Zhang, Cao & Ahn 2014). Another option for analyzing intervention effects would have been the use of mixed effects models, which would have yielded information about individual differences in change over time in addition to the average effects given by GEE (Ma, Mazumdar & Memtsoudis 2012).

6.6 Implications and future directions

Previous studies have shown that participation in different leisure activities, and especially LTPA, are related to not only current well-being and health, but also contribute to better functional capacity at an older age (Kramer et al. 1999, Singh-Manoux, Richards & Marmot 2003). The present study supports previous findings of a positive relationship between different leisure activities, LTPA and current well-being in both midlife and early old age. Because in midlife time for leisure is often limited, middle-aged adults should be encouraged to find time for leisure, and especially for LTPA, to promote both their current well-being and future functional capacity. Better well-being not only benefits middle-aged

adults themselves, but also their families, their workplace and society as a whole. This study also suggests that these associations between leisure activities and well-being may vary between different age groups and people with different life situations. These moderator effects of age and life situation merit further investigation. The possible psychological mediators between leisure activities and well-being introduced in the DRAMMA model, i.e. affiliation, autonomy, mastery, meaning and detachment-recovery (Newman, Tay & Diener 2014), should also be investigated in future research.

The present results revealed that in midlife the relationship between LTPA and well-being seems to be bidirectional: individuals with higher mental well-being participate more in LTPA. Well-being is an important resource for many areas of life, such as work and social relations (Kokko & Feldt 2018). In future studies, this reverse causality between LTPA and well-being should be better taken into account. Based on these results, middle-aged adults, especially those with lower well-being, should be targeted when promoting participation in LTPA.

To maintain sufficient levels of muscle strength and mass in older age, the importance of muscle-strengthening physical activities increases (Hunter, McCarthy & Bamman 2004). However, only a small proportion of older adults participate in specifically muscle-strengthening activities (Bennie et al. 2017). The results of the present research revealed that participation in supervised, regular RT not only has physical benefits, but can also improve aspects of well-being and characteristics related to exercise motivation. The results also give a preliminary clue that training once a week may not be enough to gain these psychological benefits. The role of training frequency on mental well-being should be further investigated.

The improvements in exercise-related motivational and volitional characteristics are especially important, as increases in exercise self-efficacy and intrinsic motivation were related to the continuance of RT after the intervention. These are the key factors that should be taken into account when planning future physical activity interventions to promote regular and continuous behavior. There is some evidence that exercise interventions with behavioral counselling are more effective in promoting continuance of exercise behavior than programs that are confined to exercise alone (Katula, Rejeski & Marsh 2008, Teixeira et al. 2012) and that even brief psychological interventions could be an effective way to improve both exercise motivation and exercise behavior (Weman-Josefsson et al. 2017). Theories on motivation and self-efficacy suggest that experiences of autonomy, competence and relatedness lead to intrinsic motivation (Ryan & Deci 2000b) and experiences of mastery, and also that witnessing the success of others contributes to self-efficacy (Bandura 1994). These are possible additional targets of future exercise interventions.

It seems that among older adults RT continues to be less familiar than more traditional aerobic activities. Older adults may still have negative preconceptions about RT and perceive it as complex and difficult (Winett, Williams & Davy 2009). This study showed that among older adults with no

previous RT background, almost half of them continued independent training after the intervention. It can therefore be assumed that familiarizing older adults with RT would increase participation rates in this mode of exercise. Start-up courses that are long enough to give the possibility to adopt training as a part of everyday life could be a possible way to achieve this objective.

7 MAIN FINDINGS AND CONCLUSIONS

The main findings of this study are:

1. Leisure activities and leisure time physical activity were positively associated with current well-being in midlife and older age. Different activities were related to different dimensions of well-being. Age may moderate these associations.

2. In midlife, leisure time physical activity did not predict mental or physical well-being eight years later. Instead, those with higher mental well-being at age 42 participated more in leisure time physical activity at age 50.

3. A nine-month supervised resistance training intervention had positive effects on some aspects of well-being and also on motivational and volitional characteristics related to exercise among older adults. Training two or three times a week seems to be more beneficial for these psychological characteristics compared to once-a-week training.

4. Improvements in intrinsic motivation and self-efficacy related to exercise predicted continuance of resistance training one year after the intervention.

YHTEENVETO (FINNISH SUMMARY)

Liikunnan, voimaharjoittelun ja muiden vapaa-ajan aktiviteettien yhteydet hyvinvointiin keski-ikäisillä ja ikääntyneillä henkilöillä

Vapaa-aika tarjoaa yksilöille mahdollisuuden viettää aikaa haluamallaan tavalla. Keski-ikäisille vapaa-aika on tärkeää rentoutumisen ja palautumisen kannalta. Vaikka keski-ikäiset voivatkin keskimäärin hyvin, tämä ikävaihe on yleensä kiireistä aikaa työhön, perheeseen ja yhteiskunnallisiin asioihin liittyvien roolien takia. Toisaalta vapaa-ajan aktiviteeteilla on keskeinen merkitys myös ikääntyessä työuran jo loputtua, sillä aktiviteetit voivat tukea fyysistä, psyykkistä ja sosiaalista toimintakykyä. Vapaa-ajan aktiviteetteihin osallistumisella on aiemmissa tutkimuksissa todettu olevan myönteinen yhteys hyvinvointiin. Vapaa-ajan aktiviteeteista erityisesti liikunnalla on hyvinvoinnin lisäksi myönteisiä vaikutuksia myös fyysiseen toimintakykyyn ja terveyteen. Silti vain harva aikuinen liikkuu terveytensä kannalta riittävästi. Tämän tutkimuksen tarkoituksena oli selvittää vapaa-ajan aktiviteettien ja hyvinvoinnin välisiä yhteyksiä keski-ikäisillä ja ikääntyneillä henkilöillä. Vapaa-ajan aktiviteeteista keskityttiin erityisesti liikuntaan ja eri liikuntamuodoista voimaharjoitteluun. Hyvinvointi määriteltiin tässä tutkimuksessa moniulotteiseksi käsitteeksi, jota tarkasteltiin emotionaalisen, psykologisen, sosiaalisen, fyysisen ja taloudellisen hyvinvoinnin kautta.

Tässä työssä hyödynnettiin aineistoja kolmesta eri tutkimusprojektista: Suomi 2014 – Kulutus ja elämäntapa -postikyselyaineistoa, Lapsesta aikuiseksi – pitkittäistutkimusta ja Voimaharjoituskerrat – satunnaistettua kontrolloitua tutkimusta (RCT). Suomi 2014 –aineiston otos (n=1304) edusti suomalaista 18-74-vuotiaista aikuisväestöä. Tässä tutkimuksessa keskityttiin erityisesti 50-74-vuotiailta (n=760) kerättyihin tietoihin. Lapsesta aikuiseksi -pitkittäistutkimuksessa samoja henkilöitä on seurattu 8-vuotiaasta 50-vuotiaaksi. Tässä tutkimuksessa hyödynnettiin tutkittavilta 42- ja 50-vuotiaana kerättyä aineistoa (n=303). Voimaharjoituskerrat –tutkimuksessa harjoitusryhmään satunnaistetut tutkittavat osallistuivat ohjattuun voimaharjoitteluun yhdeksän kuukauden ajan. Lisäksi voimaharjoittelun jatkamista seurattiin haastatteluilla vuosi ohjattua harjoittelua sisältävän intervention päättymisen jälkeen. Tutkimukseen osallistujat olivat 65-75-vuotiaita ikääntyneitä (n=104). Hyvinvointia ja vapaa-ajan aktiivisuutta kysyttiin tutkimusprojekteissa itsearviointeihin perustuvilla kyselylomakkeilla.

Tulosten perusteella erilaisilla vapaa-ajan aktiviteeteilla oli myönteinen yhteys hyvinvointiin keski-ikäisillä ja ikääntyneillä henkilöillä. Yhteydet vaihtelivat hyvinvoinnin eri osa-alueiden välillä. Esimerkiksi luovat aktiviteetit olivat yhteydessä emotionaaliseen hyvinvointiin, kävely psykologiseen hyvinvointiin, kirjallisuus ja kulttuuri taloudelliseen hyvinvointiin ja kestävyysliikunta fyysiseen hyvinvointiin. Matkailulla oli myönteinen yhteys niin emotionaaliseen, fyysiseen kuin taloudelliseen hyvinvointiin ja luonnossa liikkumisella sekä emotionaaliseen että sosiaaliseen hyvinvointiin. Yhteyksissä

oli joitakin eroja sukupuolen, iän ja elämäntilanteen suhteen. Pitkittäistulosten perusteella liikunta ei yllättäen ennustanut myöhempää hyvinvointia, vaan sen sijaan korkea mielen hyvinvointi 42-vuotiaana ennusti runsaampaa osallistumista vapaa-ajan liikuntaan 50-vuotiaana.

Vapaa-ajan aktiviteettien ja liikuntaharrastusten lisäksi tarkasteltiin voimaharjoitteluintervention psykologisia vaikutuksia. Voimaharjoitteluinterventiolla oli myönteisiä vaikutuksia ikääntyneiden hyvinvointiin. Lisäksi interventio lisäsi liikuntamotivaatiota ja liikuntasuunnitelmien tekemistä. Vastavuoroisesti liikuntamotivaation ja liikuntaan liittyvän minäpystyvyyden lisääntyminen ennustivat voimaharjoittelun jatkamista itsenäisesti intervention jälkeisen vuoden ajan.

Tulokset tukevat aiempien tutkimusten havaintoja erilaisten vapaa-ajan aktiviteettien ja hyvinvoinnin välisistä myönteisistä yhteyksistä. Lisäksi tulokset vahvistavat ajatusta siitä, että voimaharjoittelulla on fyysisten hyötyjen lisäksi myönteisiä vaikutuksia myös hyvinvointiin ja liikuntamotivaatioon. Tulosten perusteella yhteydet vapaa-ajan liikunnan ja hyvinvoinnin välillä näyttäisivät kuitenkin olevan moniulotteisia, sillä hyvinvointi myös ennusti liikunnan harrastamista. Edistettäessä liikuntaan osallistumista tulisikin kiinnittää huomiota myös mielen hyvinvointiin liikunnan harrastamista tukevana voimavarana. Lisäksi tulisi pyrkiä edistämään sisäisen motivaation ja liikuntaan liittyvien minäpystyvyysuskomusten kokemista liikuntaharrastuksen jatkuvuuden tukemiseksi.

REFERENCES

Adams, K. B., Leibbrandt, S. & Moon, H. 2011. A critical review of the literature on social and leisure activity and wellbeing in later life. Ageing & Society 31 (04), 683-712.

Agahi, N., Ahacic, K. & Parker, M. G. 2006. Continuity of leisure participation from middle age to old age. The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences 61 (6), 340-346.

Andersen, F. K., Christensen, K. & Frederiksen, H. 2007. Self-rated health and age: a cross-sectional and longitudinal study of 11,000 Danes aged 45—102. Scandinavian Journal of Public Health 35 (2), 164-171.

Antonovsky, A. 1987. Unraveling the mystery of health: how people manage stress and stay well. San Fransisco, CA: Jossey-Bass.

Arent, S. M., Landers, D. M. & Etnier, J. L. 2000. The effects of exercise on mood in older adults: a meta-analytic review. Journal of Aging and Physical Activity 8 (4), 407-430.

Aristotle (Ed.) 2009. (D. Ross. , Trans.) The Nicomachean Ethics. (Revised with an introduction and notes by L. Brow edition) New York: Oxford University Press.

Armstrong, T. & Bull, F. 2006. Development of the World Health Organization Global Physical Activity Questionnaire (GPAQ). Journal of Public Health 14 (2), 66-70.

Aro, H., Paronen, O. & Aro, S. 1987. Psychosomatic symptoms among 14–16 year old Finnish adolescents. Social Psychiatry 22, 171-176.

Bandura, A. 1994. Self-efficacy. In V. S. Ramachaudran (Ed.) Encyclopedia of human behavior. New York, NY, US: Academic Press, 71-81.

Barnett, I., van Sluijs, E. M. F & Ogilvie, D. 2012. Physical activity and transitioning to retirement: a systematic review. American Journal of Preventive Medicine 43 (3), 329-336.

Beard, J. G. & Ragheb, M. G. 1980. Measuring leisure satisfaction. Journal of Leisure Research 12 (1), 20-33.

Beck, A. T., Steer, R. A. & Brown, G. K. 1996. Manual for the Beck Depression Inventory-II. San Antonio, TX: Psychological Corporation.

Beniamini, Y., Rubenstein, J. J., Zaichkowsky, L. D. & Crim, M. C. 1997. Effects of high-intensity strength training on quality-of-life parameters in cardiac rehabilitation patients. The American Journal of Cardiology 80 (7), 841-846.

Bennie, J. A., Pedisic, Z., Suni, J. H., Tokola, K., Husu, P., et al. 2017. Self-reported health-enhancing physical activity recommendation adherence among 64,380 Finnish adults. Scandinavian Journal of Medicine & Science in Sports 27 (12), 1842-1853.

Benton, M. J. & Schlairet, M. C. 2012. Improvements in quality of life in women after resistance training are not associated with age. Journal of Women & Aging 24 (1), 59-69.

Best, S. 2010. Leisure studies: themes and perspectives. London: SAGE.

Blanchflower, D. G. & Oswald, A. J. 2008. Is well-being U-shaped over the life cycle? Social Science & Medicine 66 (8), 1733-1749.

Blomstrand, A., Björkelund, C., Ariai, N., Lissner, L. & Bengtsson, C. 2009. Effects of leisure-time physical activity on well-being among women: a 32-year perspective. Scandinavian Journal of Public Health 37 (7), 706-712.

Bonganha, V., Modeneze, D. M., Madruga, V. A. & Vilarta, R. 2012. Effects of resistance training (RT) on body composition, muscle strength and quality of life (QoL) in postmenopausal life. Archives of Gerontology and Geriatrics 54 (2), 361-365.

Brajša-Žganec, A., Merkaš, M. & Šverko, I. 2011. Quality of life and leisure activities: How do leisure activities contribute to subjective well-being? Social Indicators Research 102 (1), 81-91.

Brown, J., MacDonald, R. & Mitchell, R. 2015. Are people who participate in cultural activities more satisfied with life? Social Indicators Research 122 (1), 135-146.

Cambridge Dictionary Wellness. Available in: https://dictionary.cambridge.org/dictionary/english/wellness. Accessed: 24.5.2018.

Camfield, L. & Skevington, S. M. 2008. On subjective well-being and quality of life. Journal of Health Psychology 13 (6), 764-775.

Capio, C., Sit, C. P. & Abernethy, B. 2014. Physical well-being. In A. C. Michalos (Ed.) Encyclopedia of quality of life and well-being research. Berlin, Germany: Springer, 4805-4807.

Carstensen, L. L. 1992. Social and emotional patterns in adulthood: support for socioemotional selectivity theory. Psychology and Aging 7 (3), 331-338.

Carstensen, L. L., Isaacowitz, D. M. & Charles, S. T. 1999. Taking time seriously. A theory of socioemotional selectivity. The American Psychologist 54 (3), 165-181.

Caspersen, C. J., Powell, K. E. & Christenson, G. M. 1985. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Reports 100 (2), 126-131.

Cella, D. F. 1995. Measuring quality of life in palliative care. Seminars in Oncology 22 (2 Suppl 3), 73-81.

Chang, C., Wright, B. D., Cella, D. & Hays, R. D. 2007. The SF-36 physical and mental health factors were confirmed in cancer and HIV/AIDS patients. Journal of Clinical Epidemiology 60 (1), 68-72.

Chang, P., Lin, Y. & Song, R. 2018. Leisure satisfaction mediates the relationships between leisure settings, subjective well-being, and depression among middle-aged adults in urban China. Applied Research in Quality of Life. Advance online publication. doi: 10.1007/s11482-018-9630-3.

Chatterjee, S. & Simonoff, J. S. 2013. Handbook of regression analysis. Hoboken, New Jersey: Wiley.

Chekroud, S. R., Gueorguieva, R., Zheutlin, A. B., Paulus, M., Krumholz, H. M., et al. 2018. Association between physical exercise and mental health in 1 ·

2 million individuals in the USA between 2011 and 2015: a cross-sectional study. The Lancet Psychiatry 5 (9), 739-746.

Cheng, E. W. L. 2001. SEM being more effective than multiple regression in parsimonious model testing for management development research. Journal of Management Development 20 (7), 650-667.

Chida, Y. & Steptoe, A. 2008. Positive psychological well-being and mortality: a quantitative review of prospective observational studies. Psychosomatic Medicine 70 (7), 741-756.

Cho, D., Post, J. & Kim, S. K. 2018. Comparison of passive and active leisure activities and life satisfaction with aging. Geriatrics & Gerontology International 18 (3), 380-386.

Chodzko-Zajko, W. J., Proctor, D. N., Fiatarone Singh, M. A., Minson, C. T., Nigg, C. R., et al. 2009. American College of Sports Medicine position stand. Exercise and physical activity for older adults. Medicine and Science in Sports and Exercise 41 (7), 1510-1530.

Chun, S., Lee, Y., Kim, B. & Heo, J. 2012. The contribution of leisure participation and leisure satisfaction to stress-related growth. Leisure Sciences 34 (5), 436-449.

Cohen, J. 1992. A power primer. Psychological Bulletin 112 (1), 155-159.

Conversano, C., Rotondo, A., Lensi, E., Della Vista, O., Arpone, F., et al. 2010. Optimism and its impact on mental and physical well-being. Clinical Practice and Epidemiology in Mental Health 6, 25-29.

Craig, C. L., Marshall, A. L., Sjostrom, M., Bauman, A. E., Booth, M. L., et al. 2003. International physical activity questionnaire: 12-country reliability and validity. Medicine and Science in Sports and Exercise 35 (8), 1381-1395.

Cruz-Jentoft, A.,J., Baeyens, J.,Pierre, Bauer, J.,M., Boirie, Y., Cederholm, T., et al. 2010. Sarcopenia: European consensus on definition and diagnosis. Report of the European Working Group on Sarcopenia in Older People. Age and Ageing 39 (4), 412-423.

Csikszentmihalyi, M. 1993. Flow – the psychology of optimal experience. New York: Harper.

Dalgas, U., Stenager, E., Jakobsen, J., Petersen, T., Hansen, H., et al. 2010. Fatigue, mood and quality of life improve in MS patients after progressive resistance training. Multiple Sclerosis 16 (4), 480-490.

Damush, T. M. & Damush, J. G. J. 1999. The effects of strength training on strength and health-related quality of life in older adult women. The Gerontologist 39 (6), 705-710.

de Backer, I. C. F, Vreugdenhil, G., Nijziel, M. R., Kester, A. D., van Breda, E., et al. 2008. Long-term follow-up after cancer rehabilitation using high-intensity resistance training: persistent improvement of physical performance and quality of life. British Journal of Cancer 99 (1), 30-36.

de Bloom, J., Rantanen, J., Tement, S. & Kinnunen, U. 2018. Longitudinal leisure activity profiles and their associations with recovery experiences and job performance. Leisure Sciences 40 (3), 151-173.

de Vreede, P. L., van Meeteren, N. L., Samson, M. M., Wittink, H. M., Duursma, S. A., et al. 2007. The effect of functional tasks exercise and resistance exercise on health-related quality of life and physical activity. A randomised controlled trial. Gerontology 53 (1), 12-20.

Deci, E.L. & Ryan, R.M. 2004. Exercise self-regulation questionnaires. Self-determination theory: an approach to human motivaion and personality. Available in: http://selfdeterminationtheory.org/self-regulation-questionnaires/. Accessed: September 13, 2017.

DeLeire, T. & Kalil, A. 2010. Does consumption buy happiness? Evidence from the United States. International Review of Economics 57 (2), 163-176.

Deschenes, M. R. & Kraemer, W. J. 2002. Performance and physiologic adaptations to resistance training. American Journal of Physical Medicine & Rehabilitation 81 (11 Suppl), 3-16.

Diener, E. 1984. Subjective well-being. Psychological Bulletin 95 (3), 542-575.

Diener, E. 1994. Assessing subjective well-being: progress and opportunities. Social Indicators Research 31 (2), 103-157.

Diener, E. & Chan, M. Y. 2011. Happy people live longer: subjective well-being contributes to health and longevity. Applied Psychology: Health and Well-Being 3 (1), 1-43.

Diener, E., Emmons, R. A., Larsen, R. J. & Griffin, S. 1985. The Satisfaction With Life Scale. Journal of Personality Assessment 49 (1), 71-75.

Diener, E. & Lucas, R. E. 1999. Personality and subjective well-being. In D. Kahneman, E. Diener & N. Schwartz (Eds.) Well-being: the foundations of hedonic psychology. New York: Russell Sage Foundation, 213-229.

Diener, E., Lucas, R. E. & Scollon, C. N. 2006. Beyond the hedonic treadmill: revising the adaptation theory of well-being. The American Psychologist 61 (4), 305-314.

Diener, E., Oishi, S. & Lucas, R. E. 2003. Personality, culture, and subjective well-being: emotional and cognitive evaluations of life. Annual Review of Psychology 54, 403-425.

Diener, E. & Ryan, K. 2009. Subjective well-being: a general overview. South African Journal of Psychology 39 (4), 391-406.

Diener, E. & Suh, M. E. 1997. Subjective well-being and age: an international analysis. In K. W. Schaie & M. P. Lawton (Eds.) Annual review of gerontology and geriatrics. Vol. 17. Focus on emotion and adult development. New York, NY: Springer publishing company, 304-324.

Diener, E., Suh, E. M., Lucas, R. E. & Smith, H. L. 1999. Subjective well-being: three decades of progress. Psychological Bulletin 125 (2), 276-302.

Dodge, R., Daly, A. P., Huyton, J. & Sanders, L. D. 2012. The challenge of defining wellbeing. International Journal of Well-Being 2 (3), 222-235.

Dunn, E. W., Gilbert, D. T. & Wilson, T. D. 2011. If money doesn't make you happy, then you probably aren't spending it right. Journal of Consumer Psychology 21 (2), 115-125.

Ehrhardt, J., Saris, W. E. & Veenhoven, R. 2000. Stability of life-satisfaction over time: analysis of change in ranks in a national population. Journal of Happiness Studies 1 (2), 177-205.

Elkington, T. J., Cassar, S., Nelson, A. & Levinger, I. 2017. Psychological responses to acute aerobic, resistance, or combined exercise in healthy and overweight individuals: A systematic review. Clinical Medicine Insights: Cardiology. Advance online publication. doi: 10.1177/1179546817701725.

Englund, U., Littbrand, H., Sondell, A., Bucht, G. & Pettersson, U. 2009. The beneficial effects of exercise on BMD are lost after cessation: a 5-year follow-up in older post-menopausal women. Scandinavian Journal of Medicine & Science in Sports 19 (3), 381-388.

Ericson, H., Skoog, T., Johansson, M. & Wåhlin-Larsson, B. 2018. Resistance training is linked to heightened positive motivational state and lower negative affect among healthy women aged 65–70. Journal of Women & Aging 30 (5), 366-381.

Eriksson, I., Undén, A. & Elofsson, S. 2001. Self-rated health. Comparisons between three different measures. Results from a population study. International Journal of Epidemiology 30 (2), 326-333.

Eriksson, M. & Lindström, B. 2005. Validity of Antonovsky's sense of coherence scale: a systematic review. Journal of Epidemiology and Community Health 59 (6), 460-466.

Eriksson, M. & Lindström, B. 2006. Antonovsky's sense of coherence scale and the relation with health: a systematic review. Journal of Epidemiology and Community Health 60 (5), 376-381.

Eriksson, M. & Lindström, B. 2007. Antonovsky's sense of coherence scale and its relation with quality of life: a systematic review. Journal of Epidemiology and Community Health 61 (11), 938-944.

Fabrigar, L. R. & Wegener, D. T. 2012. Exploratory factor analysis. Oxford: Oxford Univ. Press.

Felce, D. & Perry, J. 1995. Quality of life: Its definition and measurement. Research in Developmental Disabilities 16 (1), 51-74.

Feldman, L. A. 1995. Valence arousal and arousal focus: individual differences in the structure of affective experience. Journal of Personality and Social Psychology 69 (1), 153-166.

Feldt, T., Lintula, H., Suominen, S., Koskenvuo, M., Vahtera, J., et al. 2007. Structural validity and temporal stability of the 13-item sense of coherence scale: prospective evidence from the population-based HeSSup study. Quality of Life Research 16 (3), 483-493.

Fernandez-Lezaun, E., Schumann, M., Makinen, T., Kyrolainen, H. & Walker, S. 2017. Effects of resistance training frequency on cardiorespiratory fitness in older men and women during intervention and follow-up. Experimental Gerontology 95, 44-53.

Fisher, R. A. 1915. Frequency distribution of the values of the correlation coefficient in samples from an indefinitely large population. Biometrika 10 (4), 507-521.

Fowler, J. H. & Christakis, N. A. 2008. Dynamic spread of happiness in a large social network: longitudinal analysis over 20 years in the Framingham Heart Study. Bmj 337 (a2338), doi: 10.1136/bmj.a2338.

Frijters, P. & Beatton, T. 2012. The mystery of the U-shaped relationship between happiness and age. Journal of Economic Behavior & Organization 82 (2), 525-542.

Gallagher, M. W., Lopez, S. J. & Preacher, K. 2009. The hierarchical structure of well-being. Journal of Personality 77 (4), 1025-1050.

Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., et al. 2011. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults. Medicine and Science in Sports and Exercise 43 (7), 1334-1359.

Geirsdottir, O. G., Arnarson, A., Ramel, A., Briem, K., Jonsson, P. V., et al. 2015. Muscular strength and physical function in elderly adults 6–18 months after a 12-week resistance exercise program. Scandinavian Journal of Public Health 43 (1), 76-82.

Gordon, B. R., McDowell, C. P., Hallgren, M., Meyer, J. D., Lyons, M., et al. 2018. Association of efficacy of resistance exercise training with depressive symptoms: meta-analysis and meta-regression analysis of randomized clinical trials. JAMA Psychiatry 75 (6), 566-576.

Gorman, M. 1999. Development and the rights of older people. In J. Randel, T. German & D. Ewing (Eds.) The ageing and development report: poverty, independence and the world's older people. London: Earthscan Publications Ltd, 3-21.

Hagerty, M., Land, K., Michalos, A., Ferriss, A., Peterson, M., et al. 2001. Quality of life indexes for national policy: review and agenda for research. Social Indicators Research 55 (1), 1-96.

Hagger-Johnson, G. 2014. Introduction to research methods and data analysis in the health sciences. New York: Routledge.

Halleröd, B. & Seldén, D. 2013. The multi-dimensional characteristics of wellbeing: how different aspects of wellbeing interact and do not interact with each other. Social Indicators Research 113 (3), 807-825.

Hamaker, E. L., Kuiper, R. M. & Grasman, R. P. 2015. A critique of the cross-lagged panel model. Psychological Methods 20 (1), 102-116.

Haraldstad, K., Rohde, G., Stea, T. J., Lohne-Seiler, H., Hetlelid, K., et al. 2017. Changes in health-related quality of life in elderly men after 12 weeks of strength training. European Review of Aging and Physical Activity 14 (8), doi: 10.1186/s11556-017-0177-3.

Haskell, W. L., Lee, I., Pate, R. R., Powell, K. E., Blair, S. N., et al. 2007. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Medicine and Science in Sports and Exercise 39 (8), 1423-1434.

Hassmén, P., Koivula, N. & Uutela, A. 2000. Physical exercise and psychological well-being: a population study in Finland. Preventive Medicine 30 (1), 17-25.

Hays, R. D., Sherbourne, C. D. & Mazel, R. M. 1993. The RAND 36-Item Health Survey 1.0. Health Economics 2 (3), 217-227.

Headey, B., Muffels, R. & Wagner, G. G. 2010. Long-running German panel survey shows that personal and economic choices, not just genes, matter for happiness. Proceedings of the National Academy of Sciences of the United States of America 107 (42), 17922-17926.

Heiestad, H., Rustaden, A. M., Bø, K. & Haakstad, L. A. H. 2016. Effect of regular resistance training on motivation, self-perceived health, and quality of life in previously inactive overweight women: a randomized, controlled trial. BioMed Research International, doi: 10.1155/2016/3815976.

Henning, G., Lindwall, M. & Johansson, B. 2016. Continuity in well-being in the transition to retirement. The Journal of Gerontopsychology and Geriatric Psychiatry 29 (4), 225-237.

Hooper, D., Coughlan, J. & Mullen, M. R. 2008. Structural equation modelling: guidelines for determining model fit. Electronic Journal on Business Research Methods 6 (1), 53-60.

Howell, A. J., Dopko, R. L., Passmore, H. & Buro, K. 2011. Nature connectedness: associations with well-being and mindfulness. Personality and Individual Differences 51 (2), 166-171.

Hudders, L. & Pandelaere, M. 2012. The silver lining of materialism: the impact of luxury consumption on subjective well-being. Journal of Happiness Studies 13 (3), 411-437.

Hunter, G. R., McCarthy, J. P. & Bamman, M. M. 2004. Effects of resistance training on older adults. Sports Medicine 34 (5), 329-348.

Husu, P., Tokola, K., Suni, J., Vähä-Ypyä, H., Mänttäri, A., et al. 2018. Suomalaisten objektiivisesti mitattu fyysinen aktiivisuus, paikallaanolo ja fyysinen kunto. Opetus- ja kulttuuriministeriön julkaisuja 2018:30. Helsinki: Ministry of Education and Culture, Finland.

Inaba, Y., Obuchi, S., Arai, T., Satake, K. & Takahira, N. 2008. The long-term effects of progressive resistance training on health-related quality in older adults. Journal of Physiological Anthropology 27 (2), 57-61.

Iso-Ahola, S., Jackson, E. & Dunn, E. 1994. Starting, ceasing, and replacing leisure activities over the life-span. Journal of Leisure Research 26 (3), 227-249.

Janke, M., Davey, A. & Kleiber, D. 2006. Modeling change in older adults' leisure activities. Leisure Sciences 28 (3), 285-303.

Joo, S. 2008. Personal financial wellness. In J.J. Xiao (Ed.) Handbook of consumer finance research. New York: Springer, 21-34.

Jopp, D. S. & Hertzog, C. 2010. Assessing adult leisure activities: an extension of a self-report activity questionnaire. Psychological Assessment 22 (1), 108-120.

Joshanloo, M. 2018. Investigating the relationships between subjective well-being and psychological well-being over two decades. Emotion. Advance online publication. doi: 10.1037/emo0000414.

Joshanloo, M., Sirgy, M. J. & Park, J. 2018. Directionality of the relationship between social well-being and subjective well-being: evidence from a 20-year longitudinal study. Quality of Life Research 27 (8), 2137-214.

Justine, M., Azizan, A., Hassan, V., Salleh, Z. & Manaf, H. 2013. Barriers to participation in physical activity and exercise among middle-aged and elderly individuals. Singapore Medical Journal 54 (10), 581-586.

Jylhä, M. 2009. What is self-rated health and why does it predict mortality? Towards a unified conceptual model. Social Science & Medicine 69 (3), 307-316.

Kaliterna Lipovcan, L., Brkljacic, T., Prizmic Larsen, Z., Brajša-Žganec, A. & Franc, R. 2018. Leisure activities and the subjective well-being of older adults in Croatia. The Journal of Gerontopsychology and Geriatric Psychiatry 31 (1), 31-39.

Kangasniemi, A. M., Lappalainen, R., Kankaanpää, A., Tolvanen, A. & Tammelin, T. 2015. Towards a physically more active lifestyle based on one's own values: the results of a randomized controlled trial among physically inactive adults. BMC Public Health 15 (1), 260-273.

Karimi, M. & Brazier, J. 2016. Health, health-related quality of life, and quality of life: What is the difference? PharmacoEconomics 34 (7), 645-649.

Katula, J. A., Rejeski, W. J. & Marsh, A. P. 2008. Enhancing quality of life in older adults: a comparison of muscular strength and power training. Health and Quality of Life Outcomes 6 (1), 45-52.

Katz-Gerro, T. 2004. Cultural consumption research: review of methodology, theory, and consequence. International Review of Sociology 14 (1), 11-29.

Kearney, M. W. 2017. Cross-lagged panel analysis. In M. R. Allen (Ed.) The SAGE Encyclopedia of Communication Research Methods. Thousand Oaks, CA: Sage, 313-314.

Keyes, C. L. 1998. Social well-being. Social Psychology Quarterly 61, 121-140.

Keyes, C. L. 2005. Mental illness and/or mental health? Investigating axioms of the complete state model of health. Journal of Consulting and Clinical Psychology 73 (3), 539-548.

Kinnunen, M., Kokkonen, M., Kaprio, J. & Pulkkinen, L. 2005. The associations of emotion regulation and dysregulation with the metabolic syndrome factor. Journal of Psychosomatic Research 58 (6), 513-521.

Kinnunen, M., Metsäpelto, R., Feldt, T., Kokko, K., Tolvanen, A., et al. 2012. Personality profiles and health: longitudinal evidence among Finnish adults. Scandinavian Journal of Psychology 53 (6), 512-522.

Knittle, K., Nurmi, J., Crutzen, R., Hankonen, N., Beattie, M., et al. 2018. How can interventions increase motivation for physical activity? A systematic review and meta-analysis. Health Psychology Review 12 (3), 211-230.

Koivula, A., Räsänen, P. & Sarpila, O. 2015. Working papers in economic sociology: Suomi 2014 – kulutus ja elämäntapa: tutkimusseloste ja aineistojen 1999–2014 vertailua. Turku: University of Turku.

Kokko, K. & Feldt, T. 2018. Longitudinal profiles of mental well-being as correlates of successful aging in middle age. International Journal of Behavioral Development 42 (5), 485-495.

Kokko, K., Korkalainen, A., Lyyra, A. & Feldt, T. 2013. Structure and continuity of well-being in mid-adulthood: a longitudinal study. Journal of Happiness Studies 14 (1), 99-114.

Kokko, K., Rantanen, J. & Pulkkinen, L. 2015. Associations between mental well-being and personality from a life span perspective. In M. Blatný (Ed.) Personality and well-being across the life-span. London: Palgrave, 134-159.

Kokko, K., Tolvanen, A. & Pulkkinen, L. 2013. Associations between personality traits and psychological well-being across time in middle adulthood. Journal of Research in Personality 47 (6), 748-756.

Kokkonen, M. 2001. Emotion regulation and physical health in adulthood: a longitudinal, personality-oriented approach. Jyväskylä Studies in Education, Psychology and Social Research, No. 184. Jyväskylä, Finland: University of Jyväskylä.

Kolt, G. S., George, E. S., Rebar, A. L., Duncan, M. J., Vandelanotte, C., et al. 2017. Associations between quality of life and duration and frequency of physical activity and sedentary behaviour: Baseline findings from the WALK 2.0 randomised controlled trial. PloS One 12 (6), doi: 10.1371/journal.pone.0180072.

Kowalski, K., Rhodes, R., Naylor, P., Tuokko, H. & MacDonald, S. 2012. Direct and indirect measurement of physical activity in older adults: a systematic review of the literature. International Journal of Behavioral Nutrition and Physical Activity 9 (1), doi: 10.1186/1479-5868-9-148.

Kramer, A. F., Hahn, S., Cohen, N. J., Banich, M. T., McAuley, E., et al. 1999. Ageing, fitness and neurocognitive function. Nature 400 (6743), 418-419.

Ku, P., Fox, K., Chang, C., Sun, W. & Chen, L. 2014. Cross-sectional and longitudinal associations of categories of physical activities with dimensions of subjective well-being in Taiwanese older adults. Social Indicators Research 117 (3), 705-718.

Ku, P., Fox, K. R. & Chen, L. 2016. Leisure-time physical activity, sedentary behaviors and subjective well-being in older adults: an eight-year longitudinal research. Social Indicators Research 127 (3), 1349-1361.

Kuykendall, L., Tay, L. & Ng, V. 2015. Leisure engagement and subjective well-being: a meta-analysis. Psychological Bulletin 141 (2), 364-403.

Lachman, M. E. 2004. Development in midlife. Annual Review of Psychology 55, 305-331.

Lachman, M. E., Teshale, S. & Agrigoroaei, S. 2015. Midlife as a pivotal period in the life course: balancing growth and decline at the crossroads of youth and old age. International Journal of Behavioral Development 39 (1), 20-31.

Lahti, J., Holstila, A., Mänty, M., Lahelma, E. & Rahkonen, O. 2016. Changes in leisure time physical activity and subsequent disability retirement: a register-linked cohort study. The International Journal of Behavioral Nutrition and Physical Activity 13 (1), doi: 10.1186/s12966-016-0426-2.

Leadbetter, C. & O´Connor, N. 2013. Healthy attendance? The impact of cultural engagement and sports participation on health and satisfaction with life in Scotland. Scottish Government Social Research.

LeCheminant, J. D., Hinman, T., Pratt, K. B., Earl, N., Bailey, B. W., et al. 2014. Effect of resistance training on body composition, self-efficacy, depression, and activity in postpartum women. Scandinavian Journal of Medicine & Science in Sports 24 (2), 414-421.

Lee, C. & Russell, A. 2003. Effects of physical activity on emotional well-being among older Australian women: cross-sectional and longitudinal analyses. Journal of Psychosomatic Research 54 (2), 155-160.

Lee, J. H., Lee, J. H. & Park, S. H. 2014. Leisure activity participation as predictor of quality of life in Korean urban-dwelling elderly. Occupational Therapy International 21 (3), 124-132.

Leinonen, R., Kaprio, J., Jylha, M., Tolvanen, A., Koskenvuo, M., et al. 2005. Genetic influences underlying self-rated health in older female twins. Journal of the American Geriatrics Society 53 (6), 1002-1007.

Lera-López, F. & Rapún-Gárate, M. 2007. The demand for sport: sport consumption and participation models. Journal of Sport Management 21 (1), 103-122.

Leskinen, T., Pulakka, A., Heinonen, O. J., Pentti, J., Kivimaki, M., et al. 2018. Changes in non-occupational sedentary behaviours across the retirement transition: the Finnish Retirement and Aging (FIREA) study. Journal of Epidemiology and Community Health 72 (8), 695-701.

Levinger, I., Goodman, C., Hare, D., Jerums, G., Morris, T., et al. 2009. Psychological responses to acute resistance exercise in men and women who are obese. Journal of Strength and Conditioning Research 23 (5), 1548-1552.

Levinger, I., Goodman, C., Hare, D. L., Jerums, G. & Selig, S. 2007. The effect of resistance training on functional capacity and quality of life in individuals with high and low numbers of metabolic risk factors. Diabetes Care 30 (9), 2205-2210.

Lincoln, A. K., Shepherd, A., Johnson, P. L. & Castaneda-Sceppa, C. 2011. The impact of resistance exercise training on the mental health of older Puerto Rican adults with type 2 diabetes. The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences 66 (5), 567-570.

Linton, M., Dieppe, P. & Medina-Lara, A. 2016. Review of 99 self-report measures for assessing well-being in adults: exploring dimensions of well-being and developments over time. BMJ Open 6 (7), doi: doi: 10.1136/bmjopen-2015-010641.

Liu, C. J. & Latham, N. K. 2009. Progressive resistance strength training for improving physical function in older adults. The Cochrane Database of Systematic Reviews 3 (3), doi: 10.1002/14651858.CD002759.pub2.

Lucas, R. E. & Donnellan, M. B. 2007. How stable is happiness? Using the STARTS model to estimate the stability of life satisfaction. Journal of Research in Personality 41 (5), 1091-1098.

Ma, Y., Mazumdar, M. & Memtsoudis, S. G. 2012. Beyond repeated-measures analysis of variance: advanced statistical methods for the analysis of longitudinal data in anesthesia research. Regional Anesthesia and Pain Medicine 37 (1), 99-105.

Mammen, G. & Faulkner, G. 2013. Physical activity and the prevention of depression: a systematic review of prospective studies. American Journal of Preventive Medicine 45 (5), 649-657.

Mayer, J. D. & Gaschke, Y. N. 1988. The experience and meta-experience of mood. Journal of Personality and Social Psychology 55 (1), 102-111.

McAdams, D. P. 1995. What do we know when we know a person? Journal of Personality 63 (2), 365-396.

McAuley, E. & Blissmer, B. 2000. Self-efficacy determinants and consequences of physical activity. Exercise and Sport Sciences Reviews 28 (2), 85-88.

McAuley, E. & Rudolp, D. 1995. Physical activity, aging and psychological well-being. Journal of Aging and Physical Activity 3, 67-96.

McCullough, M. E. & Polak, E. 2006. Change and stability during the third age. Longitudinal investigations of self-rated health and religiousness with the Terman sample. In J. B. James, P. Wink & K. W. Schaie (Eds.) Annual review of gerontology and geriatrics.Vol. 26. The crown of life: dynamics of the early postretirement period. New York, NY: Springer Publishing Company, 175-192.

McGuire, A., Seib, C. & Anderson, D. 2016. Factors predicting barriers to exercise in midlife Australian women. Maturitas 87, 61-66.

Meijman, T. F. & Mulder, G. 1998. Psychological aspects of workload. In P. J. Drenth, H. Thierry & C. J. de Wolff (Eds.) Handbook of work and organizational psychology. (2nd edition) Hove: Psychology Press, 5-33.

Metsäpelto, R., Polet, J., Kokko, K., Rantanen, J., Kinnunen, M., et al 2010. Tutkimuksen toteutus. In Pulkkinen, L. & Kokko, K. (Ed.) Keski-ikä elämänvaiheena. Jyväskylän yliopiston psykologian laitoksen julkaisuja 352. Jyväskylä: University of Jyväskylä, 5-19.

Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., et al. 2013. The Behavior Change Technique Taxonomy (v1) of 93 Hierarchically Clustered Techniques: Building an International Consensus for the Reporting of Behavior Change Interventions. Annals of Behavioral Medicine 46 (1), 81-95.

Milne, H., Wallman, K., Gordon, S. & Courneya, K. 2008. Impact of a combined resistance and aerobic exercise program on motivational variables in breast cancer survivors: a randomized controlled trial. Annals of Behavioral Medicine 36 (2), 158-166.

Morley, J. E., Baumgartner, R. N., Roubenoff, R., Mayer, J. & Nair, K. S. 2001. Sarcopenia. The Journal of Laboratory and Clinical Medicine 137 (4), 231-243.

Muthén, L. K. & Muthén, B. O. 2017. Mplus User's Guide. (8th edition) Los Angeles, CA: Muthén & Muthén.

Ndahimana, D. & Kim, E. 2017. Measurement methods for physical activity and energy expenditure: a review. Clinical Nutrition Research 6 (2), 68-80.

Netz, Y., Wu, M. J., Becker, B. J. & Tenenbaum, G. 2005. Physical activity and psychological well-being in advanced age: a meta-analysis of intervention studies. Psychology and Aging 20 (2), 272-284.

Neupert, S. D., Lachman, M. E. & Whitbourne, S. B. 2009. Exercise self-efficacy and control beliefs predict exercise behavior after an exercise intervention for older adults. Journal of Aging and Physical Activity 17 (1), 1-16.

Newman, D. B., Tay, L. & Diener, E. 2014. Leisure and subjective well-being: a model of psychological mechanisms as mediating factors. Journal of Happiness Studies 15 (3), 555-578.

Norris, M. K., Bell, G. J., North, S. & Courneya, K. S. 2015. Effects of resistance training frequency on physical functioning and quality of life in prostate cancer survivors: a pilot randomized controlled trial. Prostate Cancer and Prostatic Diseases 18 (3), 281-287.

O'Connor, P. J., Herring, M. P. & Caravalho, A. 2010. Mental health benefits of strength training in adults. American Journal of Lifestyle Medicine 4 (5), 377-396.

OECD 2009. Special focus: measuring leisure in OECD countries. In Society at a Glance 2009: OECD Social Indicators, 19-49.

Official Statistics of Finland 2016. Births [e-publication]. Available in: http://www.stat.fi/til/synt/2016/02/synt_2016_02_2017-12-04_tie_001_en.html. Accessed: 14.3.2018.

Oh, S. H., Son, S. H., Kang, S. H., Kim, D. K., Seo, K. M., et al. 2017. Relationship between types of exercise and quality of life in a Korean metabolic syndrome population: a cross-sectional study. Metabolic Syndrome and Related Disorders 15 (4), 199-205.

Ohira, T., Schmitz, K. H., Ahmed, R. L. & Yee, D. 2006. Effects of weight training on quality of life in recent breast cancer survivors: the Weight Training for Breast Cancer Survivors (WTBS) study. Cancer 106 (9), 2076-2083.

Pagán, R. 2015. How do leisure activities impact on life satisfaction? Evidence for German people with disabilities. Applied Research in Quality of Life 10 (4), 557-572.

Paggi, M. E., Jopp, D. & Hertzog, C. 2016. The importance of leisure activities in the relationship between physical health and well-being in a life span sample. Gerontology 62 (4), 450-458.

Pakkala, I., Read, S., Sipilä, S., Portegijs, E., Kallinen, M., et al. 2012. Effects of intensive strength-power training on sense of coherence among 60-85-

year-old people with hip fracture: a randomized controlled trial. Aging Clinical and Experimental Research 24 (3), 295-299.

Pallant, J. F. & Lae, L. 2002. Sense of coherence, well-being, coping and personality factors: further evaluation of the sense of coherence scale. Personality and Individual Differences 33 (1), 39-48.

Perho, H. & Korhonen, M. 1993. Elämänvaiheiden onnellisuus ja sisältö keski-iän kynnyksellä [Happiness and content of different life phases in the frontier of midadulthood]. Gerontologia 7, 271-285.

Pinquart, M. & Schindler, I. 2009. Change of leisure satisfaction in the transition to retirement: a latent-class analysis. Leisure Sciences 31 (4), 311-329.

Portegijs, E., Sipilä, S., Viljanen, A., Rantakokko, M. & Rantanen, T. 2017. Validity of a single question to assess habitual physical activity of community□dwelling older people. Scandinavian Journal of Medicine & Science in Sports 27 (11), 1423-1430.

Prawitz, A. D., Garman, E. T., Sorhaindo, B., O'Neill, B., Kim, J., et al. 2006. Incharge Financial Distress/Financial Well-Being Scale: Development, administration, and score interpretation. Financial Counseling and Planning 17 (1), 34-50.

Prince, S. A., Adamo, K. B., Hamel, M. E., Hardt, J., Connor Gorber, S., et al. 2008. A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. The International Journal of Behavioral Nutrition and Physical Activity 5 (1), doi: 10.1186/1479-5868-5-56.

Pulkkinen, L. 2017. Human development from middle childhood to middle adulthood: growing up to the middle-aged (In collaboration with Katja Kokko). London: Routledge.

Pulkkinen, L., Feldt, T. & Kokko, K. 2005. Personality in young adulthood and functioning in middle age. In S. Willis & M. Martin (Eds.) Middle adulthood: a lifespan perspective. Thousand Oaks: SAGE Publications, Inc, 99-141.

Pulkkinen, L. & Kokko, K. 2012. Foundational issues in longitudinal data collection. In B. Laursen, T. D. Little & N. A. Card (Eds.) Handbook of developmental research methods. New York, NY, US: The Guilford Press., 129-147.

Ragheb, M. G. 1980. Interrelationships among leisure participation leisure satisfaction and leisure attitudes. Journal of Leisure Research 12 (2), 138-149.

Ramirez-Campillo, R., Castillo, A., de la Fuente, C I, Campos-Jara, C., Andrade, D. C., et al. 2014. High-speed resistance training is more effective than low-speed resistance training to increase functional capacity and muscle performance in older women. Experimental Gerontology 58, 51-57.

Ramirez-Campillo, R., Diaz, D., Martinez-Salazar, C., Valdés-Badilla, P., Delgado-Floody, P., et al. 2016. Effects of different doses of high-speed resistance training on physical performance and quality of life in older

women: a randomized controlled trial. Clinical Interventions in Aging 11, 1797-1804.

Ratamess, N. A., Housh, T. J., Alvar, B. A., Evetoch, T. K., Kibler, W. B., et al. 2009. Progression models in resistance training for healthy adults. Medicine and Science in Sports and Exercise 41 (3), 687-708.

Read, S., Aunola, K., Feldt, T., Leinonen, R. & Ruoppila, I. 2005. The relationship between generalized resistance resources, sense of coherence, and health among Finnish people aged 65-69. European Psychologist 10 (3), 244-253.

Reiner, M., Niermann, C., Jekauc, D. & Woll, A. 2013. Long-term health benefits of physical activity – a systematic review of longitudinal studies. BMC Public Health 13, doi: 10.1186/1471-2458-13-813.

Rejeski, W. J. & Mihalko, S. L. 2001. Physical activity and quality of life in older adults. The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences 56 (2), 23-35.

Rhodes, R. E., Lubans, D. R., Karunamuni, N., Kennedy, S. & Plotnikoff, R. 2017. Factors associated with participation in resistance training: a systematic review. British Journal of Sports Medicine 51 (20), 1466-1472.

Rhyner, K. T. & Watts, A. 2016. Exercise and depressive symptoms in older adults: a systematic meta-analytic review. Journal of Aging and Physical Activity 24 (2), 234-246.

Robitschek, C. & Keyes, C. L. M. 2009. Keyes's model of mental health with personal growth initiative as a parsimonious predictor. Journal of Counseling Psychology 56 (2), 321-329.

Rodríguez, A., Látková, P. & Sun, Y. 2008. The relationship between leisure and life satisfaction: application of activity and need theory. Social Indicators Research 86 (1), 163-175.

Rook, J. W. & Zijlstra, F. R. H. 2006. The contribution of various types of activities to recovery. European Journal of Work and Organizational Psychology 15 (2), 218-240.

Ryan, R. M. & Deci, E. L. 2000a. Intrinsic and extrinsic motivations: classic definitions and new directions. Contemporary Educational Psychology 25 (1), 54-67.

Ryan, R. M. & Deci, E. L. 2000b. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist 55 (1), 68-78.

Ryan, R. M. & Deci, E. L. 2001. On happiness and human potentials: a review of research on hedonic and eudaimonic well-being. Annual Review of Psychology 52, 141-166.

Ryff, C. D. 1989. Happiness is everything, or is it? Explorations on the meaning of psychological well-being. Journal of Personality and Social Psychology 57, 1069-1081.

Ryff, C. D. & Keyes, C. L. M. 1995. The structure of psychological well-being revisited. Journal of Personality and Social Psychology 69, 719-727.

Ryff, C. D., Radler, B. T. & Friedman, E. M. 2015. Persistent psychological well-being predicts improved self-rated health over 9–10 years: longitudinal evidence from MIDUS. Health Psychology Open 2 (2), 1-11.

Samuel, D., Rowe, P., Hood, V. & Nicol, A. 2012. The relationships between muscle strength, biomechanical functional moments and health-related quality of life in non-elite older adults. Age and Ageing 41 (2), 224-230.

Sassatelli, R. 2007. Consumer culture: history, theory and politics. London: Sage Publications.

Sayer, A. A., Syddall, H. E., Martin, H. J., Dennison, E. M., Roberts, H. C., et al. 2006. Is grip strength associated with health-related quality of life? Findings from the Hertfordshire Cohort Study. Age and Ageing 35 (4), 409-415.

Scheier, M. F. & Carver, C. S. 1985. Optimism, coping and health: assessment and implication of generalized outcome expectancies. Health Psychology 4, 219-247.

Schermelleh-Engel, K., Moosbrugger, H. & Müller, H. 2003. Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. Methods of Psychological Research Online 8 (2), 23-74.

Schmiedeberg, C. & Schröder, J. 2017. Leisure activities and life satisfaction: an analysis with German panel data. Applied Research in Quality of Life 12 (1), 137-151.

Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A. & King, J. 2006. Reporting structural equation modeling and confirmatory factor analysis results: a review. The Journal of Educational Research 99 (6), 323-338.

Schwarzer, R. 2008. Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. Applied Psychology an International Review 57 (1), 1-29.

Schwarzer, R. & Renner, B. 2000. Social-cognitive predictors of health behavior. Health Psychology 19 (5), 487-495.

Schwarzer, R. & Renner, B. 2009. Health-Specific Self-Efficacy Scales. Available in: https://userpage.fu-berlin.de/health/healself.pdf. Accessed: February 27, 2018.

Seghieri, C., Desantis, G. & Tanturri, M. L. 2006. The richer, the happier? An empirical investigation in selected European countries. Social Indicators Research 79 (3), 455-476.

Selig, J. P. & Little, T. D. 2012. Autoregressive and cross- lagged panel analysis for longitudinal data. In B. Laursen, T. D. Little, N. A. Card (Ed.) Handbook of developmental research methods. New York: Guilford Press, 265-278.

Seligman, M. E. P. 2008. Positive health. Applied Psychology 57 (s1), 3-18.

Sewo Sampaio, P. Y., Ito, E. & Sampaio, R. A. C. 2013. The association of activity and participation with quality of life between Japanese older adults living in rural and urban areas. Journal of Clinical Gerontology and Geriatrics 4 (2), 51-56.

Shacham, S. 1983. A shortened version of the Profile of Mood States. Journal of Personality Assessment 47 (3), 305-306.

Shivers, J. S. & deLisle, L. J. 1997. The story of leisure: context, concepts, and current controversy. Champaign (IL): Human Kinetics.

Sillanpää, E., Häkkinen, K., Holviala, J. & Häkkinen, A. 2012. Combined strength and endurance training improves health-related quality of life in healthy middle-aged and older adults. International Journal of Sports Medicine 33 (12), 981-986.

Singh-Manoux, A., Richards, M. & Marmot, M. 2003. Leisure activities and cognitive function in middle age: evidence from the Whitehall II study. Journal of Epidemiology and Community Health 57 (11), 907-913.

Sloan, R. A., Sawada, S. S., Martin, C. K., Church, T. & Blair, S. N. 2009. Associations between cardiorespiratory fitness and health-related quality of life. Health and Quality of Life Outcomes 7 (1), doi: 10.1186/1477-7525-7-47.

Sniehotta, F. F., Scholz, U. & Schwarzer, R. 2006. Action plans and coping plans for physical exercise: a longitudinal intervention study in cardiac rehabilitation. British Journal of Health Psychology 11 (1), 23-37.

Sniehotta, F. F., Schwarzer, R., Scholz, U. & Schüz, B. 2005. Action planning and coping planning for long-term lifestyle change: theory and assessment. European Journal of Social Psychology 35 (4), 565-576.

Södergren, M., Sundquist, J., Johansson, S. & Sundquist, K. 2008. Physical activity, exercise and self-rated health: a population-based study from Sweden. BMC Public Health 8, doi: 10.1186/1471-2458-8-352.

Sonnentag, S. & Bayer, U. 2005. Switching off mentally. Journal of Occupational Health Psychology 10 (4), 393-414.

Sonnentag, S. & Fritz, C. 2007. The Recovery Experience Questionnaire: development and validation of a measure for assessing recuperation and unwinding from work. Journal of Occupational Health Psychology 12 (3), 204-221.

Sorgente, A. & Lanz, M. 2017. Emerging adults' financial well-being: a scoping review. Adolescent Research Review 2 (4), 255-292.

Sprod, J., Ferrar, K., Olds, T. & Maher, C. 2015. Changes in sedentary behaviours across the retirement transition: a systematic review. Age and Ageing 44 (6), 918-925.

Spuling, S. M., Wurm, S., Tesch-Römer, C. & Huxhold, O. 2015. Changing predictors of self-rated health: disentangling age and cohort effects. Psychology and Aging 30 (2), 462-474.

Standage, M. & Ryan, R. M. 2012. Self-determination theory and exercise motivation: Facilitating self-regulatory processes to support and maintain health and well-being. In G. C. Roberts & D. C. Treasure (Eds.) Advances in motivation in sport and exercise. Champaign, IL: Human Kinetics., 233-270.

Steel, P., Schmidt, J. & Shultz, J. 2008. Refining the relationship between personality and subjective well-being. Psychological Bulletin 134 (1), 138-161.

Steele, J., Raubold, K., Kemmler, W., Fisher, J., Gentil, P., et al. 2017. The effects of 6 months of progressive high effort resistance training methods upon strength, body composition, function, and wellbeing of elderly adults. BioMed Research International 2017, doi: 10.1155/2017/2541090.

Stenholm, S., Pulakka, A., Kawachi, I., Oksanen, T., Halonen, J. I., et al. 2016. Changes in physical activity during transition to retirement: a cohort study. The International Journal of Behavioral Nutrition and Physical Activity 13, doi: 10.1186/s12966-016-0375-9.

Strain, L. A., Grabusic, C. C., Searle, M. S. & Dunn, N. J. 2002. Continuing and ceasing leisure activities in later life: a longitudinal study. The Gerontologist 42 (2), 217-223.

Sullivan, G. M. & Feinn, R. 2012. Using effect size-or why the p value is not enough. Journal of Graduate Medical Education 4 (3), 279.

Svedberg, P., Gatz, M., Lichtenstein, P., Sandin, S. & Pedersen, N. L. 2005. Self-rated health in a longitudinal perspective: a 9-year follow-up twin study. The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences 60 (6), 331-340.

Sylvia, L. G., Bernstein, E. E., Hubbard, J. L., Keating, L. & Anderson, E. J. 2014. Practical guide to measuring physical activity. Journal of the Academy of Nutrition and Dietetics 114 (2), 199-208.

Takeda, F., Noguchi, H., Monma, T. & Tamiya, N. 2015. How possibly do leisure and social activities impact mental health of middle-aged adults in Japan?: An evidence from a national longitudinal survey. PloS One 10 (10), doi: 10.1371/journal.pone.0139777.

Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N. & Ryan, R. M. 2012. Exercise, physical activity, and self-determination theory: a systematic review. The International Journal of Behavioral Nutrition and Physical Activity 9 (1), 78-107.

Tessier, S., Vuillemin, A., Bertrais, S., Boini, S., Le Bihan, E., et al. 2007. Association between leisure-time physical activity and health-related quality of life changes over time. Preventive Medicine 44 (3), 202-208.

The International Wellbeing Group 2013. Personal Wellbeing Index: 5th Edition. Melbourne: Australian Centre on Quality of Life, Deakin University.

Thorp, A. A., Owen, N., Neuhaus, M. & Dunstan, D. W. 2011. Sedentary behaviors and subsequent health outcomes in adults: a systematic review of longitudinal studies, 1996-2011. American Journal of Preventive Medicine 41 (2), 207-215.

Touvier, M., Bertrais, S., Charreire, H., Vergnaud, A., Hercberg, S., et al. 2010. Changes in leisure-time physical activity and sedentary behaviour at retirement: a prospective study in middle-aged French subjects. The International Journal of Behavioral Nutrition and Physical Activity 7 (1), doi: 10.1186/1479-5868-7-14.

Trottier, A. N., Brown, T., Hobson, S. & Miller, W. 2002. Reliability and validity of the Leisure Satisfaction Scale (LSS –short form) and the Adolescent Leisure Interest Profile (ALIP). Occupational Therapy International 9 (2), 131-144.

Turpela, M., Häkkinen, K., Haff, G. G. & Walker, S. 2017. Effects of different strength training frequencies on maximum strength, body composition and functional capacity in healthy older individuals. Experimental Gerontology 98, 13-21.

U.S. Department of Health and Human Services 2008. 2008 Physical activity guidelines for Americans. Available in: https://health.gov/paguidelines/pdf/paguide.pdf. Accessed: 28.8.2018.

Van Boven, L. & Gilovich, T. 2003. To do or to have? That is the question. Journal of Personality and Social Psychology 85 (6), 1193-1202.

Van Der Ploeg, H. P., Merom, D., Chau, J. Y., Bittman, M., Trost, S. G., et al. 2010. Advances in population surveillance for physical activity and sedentary behavior: reliability and validity of time use surveys. American Journal of Epidemiology 172 (10), 1199-1206.

Van Roie, E., Bautmans, I., Coudyzer, W., Boen, F. & Delecluse, C. 2015. Low- and high-resistance exercise: long-term adherence and motivation among older adults. Gerontology 61 (6), 551-560.

Veenhoven, R. 2000. The four qualities of life. Journal of Happiness Studies 1 (1), 1-39.

von Humboldt, S., Leal, I. & Pimenta, F. 2015. Sense of coherence, sociodemographic, lifestyle, and health-related factors in older adults' subjective well-being. International Journal of Gerontology 9 (1), 15-19.

Walker, S., Haff, G. G., Häkkinen, K. & Newton, R. U. 2017. Moderate-load muscular endurance strength training did not improve peak power or functional capacity in older men and women. Frontiers in Physiology 8, doi: 10.3389/fphys.2017.00743.

Waller, B., Munukka, M., Multanen, J., Rantalainen, T., Pöyhönen, T., et al. 2013. Effects of a progressive aquatic resistance exercise program on the biochemical composition and morphology of cartilage in women with mild knee osteoarthritis: protocol for a randomised controlled trial. BMC Musculoskeletal Disorders 14 (1), doi: 10.1186/1471-2474-14-82.

Wanderley, F. A. C., Oliveira, N. L., Marques, E., Moreira, P., Oliveira, J., et al. 2013. Aerobic versus resistance training effects on health-related quality of life, body composition, and function of older adults. Journal of Applied Gerontology 34 (3), 143-165.

Wang, F., DesMeules, M., Luo, W., Dai, S., Lagace, C., et al. 2011. Leisure-time physical activity and marital status in relation to depression between men and women: a prospective study. Health Psychology 30 (2), 204-211.

Wanner, M., Hartmann, C., Pestoni, G., Martin, B. W., Siegrist, M., et al. 2017. Validation of the Global Physical Activity Questionnaire for self-administration in a European context. BMJ Open Sport & Exercise Medicine 3 (1), doi: 10.1136/bmjsem-2016-000206.

Warburton, D. E. R., Charlesworth, S., Ivey, A., Nettlefold, L. & Bredin, S. S. D. 2010. A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. The International Journal of Behavioral Nutrition and Physical Activity 7, doi: 10.1186/1479-5868-7-39.

Waterman, A. S. 1993. Two conceptions of happiness: contrasts of personal expressiveness (eudaimonia) and hedonic enjoyment. Journal of Personality and Social Psychology 64 (4), 678-691.

Watson, D., Clark, L. A. & Tellegen, A. 1988. Development and validation of brief measures of positive and negative affect: the PANAS scales. Journal of Personality and Social Psychology 54 (6), 1063-1070.

Weman-Josefsson, K., Fröberg, K., Karlsson, S. & Lindwall, M. 2017. Mechanisms in self-determined exercise motivation: effects of a theory informed pilot intervention. Current Psychology 36 (1), 90-100.

Weman-Josefsson, K., Lindwall, M. & Ivarsson, A. 2015. Need satisfaction, motivational regulations and exercise: moderation and mediation effects. International Journal of Behavioral Nutrition and Physical Activity 12 (1), doi: 10.1186/s12966-015-0226-0.

Wendel-Vos, G. C., Schuit, A. J., Tijhuis, M. A. & Kromhout, D. 2004. Leisure time physical activity and health-related quality of life: cross-sectional and longitudinal associations. Quality of Life Research 13 (3), 667-677.

Wheaton, B. 2010. Introducing the consumption and representation of lifestyle sports. Sport in Society 13 (7-8), 1057-1081.

Wiese, C. W., Kuykendall, L. & Tay, L. 2018. Get active? A meta-analysis of leisure-time physical activity and subjective well-being. The Journal of Positive Psychology 13 (1), 57-66.

Wilson, I. B. & Cleary, P. D. 1995. Linking clinical variables with health-related quality of life. A conceptual model of patient outcomes. The Journal of the American Medical Association 273 (1), 59-65.

Windle, G., Hughes, D., Linck, P., Russell, I. & Woods, B. 2010. Is exercise effective in promoting mental well-being in older age? A systematic review. Aging & Mental Health 14 (6), 652-669.

Winett, R. A., Williams, D. M. & Davy, B. M. 2009. Initiating and maintaining resistance training in older adults: a social cognitive theory-based approach. British Journal of Sports Medicine 43 (2), 114-119.

Wolf, I. D. & Wohlfart, T. 2014. Walking, hiking and running in parks: a multidisciplinary assessment of health and well-being benefits. Landscape and Urban Planning 130, 89-103.

World Health Organization 1948. Definition of health. Preamble to the Constitution of WHO as adopted by the International Health Conference, New York, 19 June - 22 July 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of WHO, no. 2, p. 100) and entered into force on 7 April 1948.

World Health Organization 1998. Development of the World Health Organization WHOQOL-BREF quality of life assessment. The WHOQOL Group. Psychological Medicine 28 (3), 551-558.

World Health Organization 2010. Global recommendations on physical activity for health. Geneva: World Health Organization.

World Health Organization 2013. Measurement of and target-setting for well-being: an initiative by the WHO Regional Office for Europe. Second meeting of the expert group. Copenhagen: WHO Regional Office for Europe.

Xu, Q., Anderson, D. & Courtney, M. 2010. A longitudinal study of the relationship between lifestyle and mental health among midlife and older women in Australia: findings from the Healthy Aging of Women study. Health Care for Women International 31 (12), 1082-1096.

Zhang, S., Cao, J. & Ahn, C. 2014. A GEE approach to determine sample size for pre- and post-intervention experiments with dropout. Computational Statistics & Data Analysis 69, 114-121.

INCLUDED PUBLICATIONS

I

LEISURE CONSUMPTION AND WELL-BEING AMONG OLDER ADULTS: DOES AGE OR LIFE SITUATION MATTER?

Kekäläinen T, Wilska T-A, Kokko K. 2017.

Applied Research in Quality of Life 12 (3): 671–691

Applied Research Quality Life (2017) 12:671–691
DOI 10.1007/s11482-016-9483-6

Leisure Consumption and well-Being among Older Adults: Does Age or Life Situation Matter?

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Received: 15 December 2015 / Accepted: 22 July 2016 / Published online: 30 July 2016

Abstract This study investigated the associations between leisure consumption and well-being in older adults (50–74 years old). To find out whether these associations are age-specific, they were compared with the associations observed among younger adults (18–49 years old). Differences between the older adults by age and life situation were also examined. This study was based on the "Finland 2014 – Consumption and Life style" survey (N = 1351), conducted among a representative sample of the Finnish adult population. Well-being was measured as mental, economic and physical well-being. Objects of leisure consumption were grouped by factor analysis, and the associations between the resulting leisure consumption factors and the dimensions of well-being were studied using regression analysis. In addition, interaction terms were used to compare differences in the associations between younger and older adults, and among older adults varying in their life situation. In the older adults, appearance was related to better mental well-being, literature & culture to better economic well-being, and exercise to better physical well-being. Travel was linked positively to all the dimensions of well-being, and health care negatively to mental and physical well-being. Some differences in the

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associations were observed between the younger and older adults; for example, exercise but not appearance was associated with better emotional well-being among the younger adults. In general, the associations were stronger in the older than younger adults. Among the older adults, age, employment status, and marital status moderated some associations. Further research, especially with longitudinal data, is needed to clarify the causal relationships between leisure consumption and well-being.

Keywords Leisure · Consumption · Emotional well-being · Physical well-being · Economic well-being · Older adults

Introduction

Well-Being

Many studies have investigated the associations between leisure and well-being. A key problem with much of the literature has been inconsistent use of the concept of well-being, as there is no general agreement on what well-being is. Multiple terms, such as happiness, quality of life and life satisfaction have been used to refer to well-being. Diener (2006) defined well-being as an umbrella term that covers people's subjective valuations of their lives. Recently it has become generally accepted that well-being is a multidimensional construct (Dodge et al. 2012; Halleröd and Seldén 2013). Hence this study investigated perceptions of well-being according to three dimensions: mental well-being, economic well-being and physical well-being.

Mental well-being has mostly been studied in the field of psychology, where well-being is divided, for example, into emotional (i.e. subjective) well-being and psychological well-being (Ryan and Deci 2001). Emotional well-being includes the dimensions of happiness, positive affectivity, low negative affectivity and general satisfaction with life, whereas psychological well-being comprises dimensions related to the meaning of life and personal growth (Keyes 1998; Ryan and Deci 2001; Kokko et al. 2013). In this study, we focus only on the emotional dimension of mental well-being.

Economic and financial well-being are often used interchangeably (Joo 2008). In the social sciences, economic well-being is frequently equated with a "decent" standard of living, meaning the ability to lead a lifestyle that accords with the prevailing norms in society (e.g. Halleröd et al. 2006; Hamilton 2009; Aro and Wilska 2014). In previous research, economic well-being has been measured either by objective measurements, such as income and wealth, or by subjective questions. In this study, following the latter approach, we measure economic well-being by self-evaluated economic situation and socio-economic position.

A generally accepted definition of physical well-being is lacking, but in previous research it usually refers to both subjectively and objectively measured aspects of health. It has also been linked to the term health-related quality of life (Capio et al. 2014), and has been closely equated with physical health. The most widely used subjective measurement of physical well-being is self-rated or perceived health (Eriksson et al. 2001), which correlates strongly with objective health measurements (Wu et al. 2013), and is an independent predictor of mortality (Idler and Benyamini 1997). In this study, physical well-being was measured as self-rated health.

Older Adults as Leisure Consumers

Previous research has indicated that leisure time relates to well-being. A recent review (Adams et al. 2011) and meta-analysis (Kuykendall et al. 2015) showed that active leisure is associated with higher well-being. Leisure activities have usually been measured by frequency or the amount of time spent on them. Money spent on leisure activities has been less used as a measurement instrument, despite the fact that nowadays leisure and consumption are hard to separate. It has been argued that the lives of postmodern citizens increasingly revolve around leisure and entertainment (e.g. Bryman 2004; Ritzer 2010). Spending on leisure activities and leisure products are also seen as reflecting a person's values, attitudes and lifestyle (Miles 1998; Taylor 2002; Katz-Gerro 2004; Sassatelli 2007; Smith 2008; Wheaton 2010).

Participation in leisure activities requires that an individual has free time after going to work and doing housework. Activities involving consumption also require that the individual has the necessary financial resources. Leisure time has increased during the past twenty years in Finland (Official Statistics of Finland 2011), the context of the present study, while the same rising trend is also apparent, for instance, in the United States and Canada (OECD 2009). As expected, retired people have more leisure time than individuals of working age. Furthermore, in all the OECD countries, 45- to 64 year-olds have more leisure time than younger adults (aged 25─44) (OECD 2009). The same group also has the highest expenditure on consumption, both overall and on leisure (Official Statistics of Finland 2012).

No general definition or age range exists for older adults. According to Yoon et al. (2009), in consumer research even 50-year-olds may be called senior consumers. Yoon et al. (2009) also point out that older adults can be divided into different subgroups: youngest olds (50–59 years), younger olds (60–74), older olds (75–84) and oldest olds (85+). Of these subgroups, the first two have more money to spend on leisure than younger adults, and better health than the oldest ones, and hence more opportunities for active leisure (Yoon et al. 2009). The amount of consumption tends to decrease with age, and people over 75, in particular, spend less on leisure and entertainment than younger age groups (Official Statistics of Finland 2012; Foster 2015). In light of these findings, this study focuses on the associations between leisure consumption and well-being among older adults, in this instance, 50- to 74-year-olds.

Leisure Consumption and Well-Being

Adequate material situation, usually measured by income and/or wealth, is a prerequisite for leisure consumption, and also for well-being. Veenhoven and Ehrhardt (1995) propose the livability theory (also known as need theory), according to which better living conditions are associated with greater happiness. However, this association holds only until basic human needs are fulfilled. Thereafter, expenditure on luxuries no longer increases happiness (Veenhoven and Ehrhardt 1995). This is also in line with the findings of Easterlin (2002), who suggests that person's happiness increases with income, but only up to a certain point. The role of material situation in well-being also depends on how well-being is measured (Christoph 2010): according to Headey et al. (2008), income, wealth and consumption are associated with better life satisfaction,

particularly with the material standard of living (based on subjective evaluations of income and financial situation).

Leisure consumption can be considered extra consumption, which is possible after the basic needs are fulfilled. According to DeLeire and Kalil (2010), after controlling for material situation and other demographic factors, spending on leisure activities was associated with happiness, unlike spending on everyday necessities or durable goods. They also found that the association between leisure consumption and subjective well-being was, at least partly, mediated by social connectedness. Hence it was not leisure consumption as such but social connections during leisure that was linked to better well-being. Therefore the links between leisure consumption and well-being may result more from leisure content than the amount of consumption. While consumption has been seen as a part of economic well-being, along with income and wealth (Headey et al. 2008), leisure consumption may rather indicate preferences in one's investment in leisure and different leisure activities than solely economic well-being. In this study, we take consumption as a proxy for leisure activities. However, research on leisure, consumption and well-being is not free of problems. One problematic issue is the narrow definition of well-being, often measured solely as emotional well-being, using indicators such as happiness, used in much of the previous consumption and well-being research. Another is the lack of studies comparing different kinds of leisure consumption in relation to well-being. Moreover, the associations between leisure and well-being may also differ at different stages of life. Our purpose was to contribute to filling these gaps in the literature.

Leisure activities may have specific associations with different dimensions of well-being. This has been pointed out by Lee et al. (2014), who investigated the associations between various leisure activities and dimensions of quality of life. Time spent on media use (such as watching TV, reading newspapers, accessing the internet) as well as on sport and outdoor activities was associated with psychological and overall quality of life. Media use was also associated with social relationships, whereas sport and outdoor activities were related to the physical quality of life. To the best of our knowledge, apart from that study, hardly any research exists in which different dimensions of well-being (or concepts bearing any similarity to well-being) have been compared.

In relation to leisure and consumption, the mental dimension of well-being has been the most studied, mainly using such indicators of emotional well-being, as happiness, life satisfaction and affectivity. For example, spending on leisure travel and sports has been associated with happiness (DeLeire and Kalil 2010) and participating in culture with life satisfaction (Leadbetter and O′Connor 2013). Consumption of luxury products has also been associated with better life satisfaction and positive affectivity, but this association is stronger among people with materialistic values (Hudders and Pandelaere 2012). However, in general, happiness has been related to altruistic use of money, spending on experiences rather than on material products and spending on small pleasures often rather than on big purchases rarely (Van Boven and Gilovich 2003; Dunn et al. 2011). Of the well-being dimensions, physical well-being has been less studied with respect to leisure activity and consumption, and in the studies reported it has mostly been measured by self-rated health. Participation in leisure physical activity in particular (Penedo and Dahn 2005; Galan et al. 2010; Leadbetter and O′Connor 2013), but also participation in culture (Leadbetter and O′Connor 2013) have been associated with better self-rated health. Economic well-being, in turn, has hardly been

studied in relation to leisure. However, it is reasonable to assume that the association between leisure consumption and economic well-being is bidirectional. That is, on the one hand, economic well-being can be considered a prerequisite for high expenditure on leisure, while, on the other hand, leisure-related consumption may promote feelings of economic well-being.

Moderators of Leisure Activities and Well-Being

Associations between leisure consumption and well-being may differ among age groups. These differences may be a result of different goals and values held by at different ages. According to the socioemotional selectivity theory (Carstensen et al. 1999), older adults concentrate more on social goals related to emotion regulation, and spend time with their families to obtain positive feelings. Younger adults favor social goals related to knowledge acquisition and try to achieve these by developing new social relationships (Carstensen et al. 1999). Windsor and Anstey (2010) have also reported that social interaction with friends has a stronger association with emotional well-being among younger adults, whereas among middle aged adults greater emotional well-being is derived from social interaction with their family. Personal goals and their achievement are important to well-being (e.g. Sheldon and Elliot 1999; Hietalahti et al. 2016), and leisure activities and consumption may offer a means to this end (Adams et al. 2011; Moschis 2012). Brajša-Žganec et al. (2011) showed that the associations between leisure activities and emotional well-being (measured by life satisfaction and happiness) were somewhat different between different age groups. Socializing and going out was associated with emotional well-being in persons aged 31–60, but not among the older participants. Additionally, visiting cultural events was linked to emotional well-being among participants aged over 30, but not among 18- to 30-year-olds. These findings support the socioemotional selectivity theory. With the exception of this study by Brajša-Žganec et al., research on age differences in relation to leisure and well-being is nonexistent.

In addition to personal goals, older and younger adults may also have different values. According to Schwartz's theory of basic values (Schwartz 2006, 2012) and the empirical evidence in support of it (e.g. Gouveia et al. 2015), basic personal values differ by age. In general, conservational values (e.g. tradition) are more important to older adults whereas values related to openness to change (e.g. hedonism) are more important to younger adults. These changes in personal values with age may originate from different life stages or physical aging, and are in line with the changes observed in personal goals (Schwartz 2006, 2012; Gouveia et al. 2015). Personal values may also guide consumer behavior (Schwartz 2006). Hudders and Pandelaere (2012) showed that the positive association between luxury consumption and emotional well-being is stronger among individuals with materialistic values. It has further been shown that younger adults have more materialistic values than older adults (Valkeneers and Vanhoomissen 2012). Hence these results support the idea that, owing to different personal values, different types of leisure consumption may be related to well-being in younger and older adults. For this reason and to better understand age-specific associations, it is important to compare older and younger adults.

There may also be differences within older adults, and thus they should not be seen as a homogenous group (Yoon et al. 2009). First of all, the age difference between a 50-

year-old and a 74-year-old individual is almost twenty-five years. To take this into account, we investigated possible age differences between older adults by dividing them into two subgroups: ages 50–61 and ages 62–74. Henceforth, we refer to the 50- to 61- year-olds as older middle-aged and the 62- to 74-year-olds as young olds. Second, the life situations of older adults may also moderate the associations between leisure consumption and well-being. For example, individuals in working life and those in retirement have different leisure-time possibilities. It has been shown that satisfaction with and engagement in leisure are more strongly associated with emotional well-being among retired people than people still in working life (Kuykendall et al. 2015). Marital status has been found to moderate the associations between leisure time physical activity and depression (Wang et al. 2011), and different leisure activities were associated with quality of life among urban and rural older adults (Sewo Sampaio et al. 2013). According to these observations, work situation, marital status and residential area are considered possible moderators in the present study. Since gender, education, and income have been associated with both consumption patterns (e.g. Headey et al. 2008; Le Roux et al. 2008; Segal and Podoshen 2013) and well-being (Diener et al. 1999; Dolan et al. 2008), they were controlled for in this study.

Aim of the Study and Study Questions

The aim of this study was to investigate the associations between various types of leisure consumption and different dimensions of well-being in older adults, i.e. persons aged 50–74. In order to analyze whether the obtained associations are age-specific, they were compared with the associations observed for younger adults (18–49). We also investigated whether age or life situation moderated these associations among older adults. We used a representative sample of the Finnish population aged 18–74 (n = 1351). The main research questions were:

1. What kinds of leisure consumption are associated with mental, economic and physical well-being among older adults and do these associations differ from those among younger adults?
2. Are there differences in these associations among older adults with respect to age or life situation?

On the basis of the previous research, we hypothesized, first that different kinds of leisure consumption are associated with different domains of well-being. For example, we expected spending on culture to be associated with mental well-being, and spending on exercise with physical well-being. Second, we hypothesized that some associations are specific to older adults. For example, culture may be more important to well-being of older adults, while for younger adults appearance may be more important. Third, we assumed that age and life situation may modify these associations among older adults. The associations between leisure consumption and well-being may be stronger among retired older adults than among older adults still in working life. The associations may also be stronger among unpartnered than partnered older adults. There may also be differences between types of residential area; for example technology and culture may be linked to well-being among older adults in urban areas, but not among those in rural areas.

Data and Methods

Data

The data for this study were drawn from the "Finland 2014 – Consumption and Way of Life" survey. The survey investigated attitudes and values towards consumption and consumption practices as well as lifestyle indicators among the Finnish population (Koivula et al. 2015). This study used the data collected in 2014, when the target sample was 3000 Finnish speaking participants aged 18–74. The sample was selected from the Central Register of Population database by random sampling (Koivula et al. 2015). The survey was sent to 2971 participants. The responses could be sent by regular mail or via the internet. For those who did not answer, even after the first reminder, the survey was sent again one month later, and a second reminder two weeks thereafter. After all, 46 % ($N = 1351$) of sample answered the survey, and 760 of the participants were aged 50 or older.

Compared to the Finnish population, the sample was representative, but slightly skewed for gender and age. Women answered more frequently than men, and participants aged 65–74 were over-represented and participants aged 18–45 under-represented. Therefore, the data contained weight variable calculated for gender and age, which corrected the skewness (Koivula et al. 2015). When the weight variable was used, the analyses were conducted with an older adult sample size smaller ($N = 589$) than the original sample size ($N = 760$), as older adults were over represented in the final sample.

Measures

Leisure Consumption Participants were asked to state, on a response scale from 1 (much more) to 5 (much less), how much they spend on different goods and services compared to the "average" consumer. To simplify interpretation of the analyses, the responses were reverse-scored, a bigger value representing a higher level of consumption. 15 variables on the amounts of time and money spent on leisure were included in the factor analysis.

Well-Being Emotional well-being (EmWB) was constructed using two questions: "How happy are you in general?" and "How satisfied are you with your life at present?" Answers were given on a scale from 1 (very happy/satisfied) to 5 (very unhappy/dissatisfied). The responses were reverse-scored and their mean value formed the EmWB variable (Cronbach's alpha 0.86). Economic well-being (EcWB) was measured by items on financial situation and occupational/social status using the same reverse-scored scale. The mean value formed the EcWB variable (Cronbach's alpha 0.71). Physical well-being was measured by self-rated health (SRH) with the question "How would you describe your health in general?" on a response scale from 1 (very good) to 5 (very bad). Because only 1.7 % ($n = 23$) of the participants estimated their health as very bad, values 4 and 5 were combined and then reverse-scored in the same way as the other variables.

Age Participants were divided into two age groups: 18–49 (0) and 50–74 (1). This binary variable was used when comparing the older adults with the younger ones. All

the other analyses were conducted only for the older age group (1). The older adults were also subdivided into two age groups: 50–61 (0) and 62–74 (1). This variable was used in answering research question 2.

Life Situation Life situation was measured by employment status, marital status, and residential area. Employment status was asked with the alternatives employed/laid off, unemployed/job applicant, study, retired, and other. Because the interest was in investigating differences between employed and retired older adults, we formed a binary variable: employed (0) and retired (1). Of the older adults, 45 % were employed, 48 % were retired, and only 7 % were not either employed or retired. Marital status was asked with the alternatives single, cohabitation, married/registered partnership, divorced or widow. For the analyses, these alternatives were collapsed into a binary variable, living without a partner (0) including single, divorced and widowed, or living with a partner (1) including cohabiting and married/registered partnership. 73 % of the older adults were living with a partner. The residential area variable was binary: the options were urban area (0) and rural area (1). 76 % of the older adults were urban residents.

Control Variables Analyses were controlled for income, educational background, gender and age. For income we calculated the variable household's income per consumption unit. When calculating income per consumption unit, we used the OECD'-s adjusted consumption unit scale recommended by Eurostat, which takes differences in household size into account. The consumption unit (K) was calculated using the traditional OECD scale: $K = 1 + (0.7*(a-1) + 0.5*b)$, where a = adults in household (aged 18 and over) and b = children in household (aged under 18). Educational background was measured as education after comprehensive school on a 7-category scale. Gender was a binary variable with male (0) and female (1). Age as a continuous variable was used as a control variable in the regression analysis for the separate age groups.

Data Analyses

The data analyses were performed using IBM SPSS Statistics 22.0 (IBM Corp. 2013). Little's MCAR test was applied first and it showed that missing values were missing completely at random. This allowed us to exclude missing values pairwise. A significance level of 95 % was used in all statistical analyses. Weight (adjusted by gender and age) was used in all analyses with the exception of the regression analyses, where gender and age, among other variables, were used as control variables.

First, factor analysis was used to compress the dimensions of leisure consumption. The extraction method of Principal axis factoring and the rotation method of Oblimin with Kaiser Normalization were used. Variables were included in a factor only if their factor loading was above 0.4 (recommendation of Stevens 2009). The factor analysis identified four factors (with Eigenvalues >1), as presented in Table 1, along with Cronbach's alpha levels that were satisfactory given the small number of variables per factor. These four factors combined explain 44 % of the variance. On the basis of the variable loadings on each factor, average sum scores for the four leisure consumption factors were calculated and used in the further analyses. Travel,

exercise and health care did not load sufficiently on any factor, and hence were used separately in the analyses.

Multiple regression analyses were conducted to examine what kinds of leisure consumption best explained the well-being variables. EmWB and EcWB were analyzed with linear regression using the enter method. The control variables were age, gender, education and income. Although the leisure consumption variables exercise, travel and health care, and the control variable education, were ordinal, they were used as a continuous variables in all analyses after their linear association with the dependent variables was confirmed. This is commonly done if there are at least 5 categories (Hagger-Johnson 2014, pp. 246). Because SRH was an ordinal variable with four categories, it was analyzed with cumulative odds ordinal logistic regression with proportional odds. The link function used in all the ordinal regressions was logit. Otherwise ordinal regression was performed in the same way as linear, and thus all the consumption variables and control variables were added to the model simultaneously.

Possible interactions between leisure consumption variables and age, marital status, employment status and residential area were also investigated. These interactions were tested as we hypothesized that these variables might moderate the associations between leisure consumption and well-being. All the possible moderators were binary variables coded 0 and 1. Because the leisure consumption variables were continuous, they were standardized before calculating the interaction terms, as is generally recommended (Dawson 2014). The interaction terms were first tested in the regression analyses,

Table 1 Rotated factor loadings, Eigenvalues and Cronbach's alpha for the leisure consumption factors (n = 1340)

Variable	Factor loading	Eigenvalue	Alpha
Technology		1.32	.67
Entertainment electronics	.74		
Telecommunications	.51		
Movies, videos etc.	.45		
Transport	.41		
Indulgence		1.36	.71
Having fun, socializing	.83		
Alcohol	.56		
vSelf-pampering	.42		
Appearance		4.73	.71
Clothes	.68		
Beauty care	.67		
Home decorations	.50		
Literature & culture		1.01	.63
Culture	.96		
Literature	.44		

Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.86

Bartlett's Test of Sphericity: Approx. Chi-Square = 5213.000, df 105, $p < .001$

which included only the main variables (leisure consumption variable and moderator variable) and interaction term. Thereafter, only statistically significant interaction terms were taken for the regression analyses with all the consumption and control variables (final models). Since the purpose was to investigate the existence of different kinds of interactions, and not to compare them, all the significant interaction terms were tested separately in the final models. This procedure was the same in both the linear and ordinal regressions for all the well-being variables. The interaction terms, which remained significant in the final models, are shown in the figs. to clarify the interpretation. For the figures, the consumption variables, rated on a scale of 1 to 5, were collapsed into three categories: low < 2,5; 2,5 ≤ medium ≤3,5; and high > 3,5.

Results

Descriptive Statistics

Older adults' descriptive statistics are presented in Table 2 with comparison data on younger adults. In the well-being measurements, the older adults, compared to the younger adults ($p < .001$) gave weaker self-ratings only for health. Otherwise, no statistically significant differences in EmWB or EcWB were observed between the two age groups. Of the leisure consumption objects, the older adults spent the most on health care, travel and exercise, and the least on appearance and indulgence. In comparison with the younger adults, they spent more on health care, and less on technology, indulgence and appearance.

The associations between leisure consumption and well-being were first examined using Spearman's correlation. The correlation matrix (presented in Table 3) shows that among the older adults almost every type of consumption correlated significantly with all the well-being variables. The perception of higher than average consumption was

Table 2 Descriptive statistics of the younger (n = 729) and older participants (n = 589): t-test comparisons

	18–49 y		50–74 y		t-test
	Mean	sd	Mean	sd	p
Emotional well-being	3.82	0.76	3.78	0.75	.361
Economic well-being	3.53	0.71	3.46	0.68	.090
Self-rated health	2.83	0.88	2.49	0.86	<.001
Technology	2.47	0.69	2.15	0.64	<.001
Indulgence	2.46	0.82	2.08	0.74	<.001
Literature & culture	2.25	0.90	2.21	0.87	.401
Appearance	2.14	0.76	2.01	0.71	.001
Exercise	2.68	1.07	2.60	1.01	.147
Travel	2.69	1.18	2.61	1.17	.181
Health care	2.38	0.93	2.67	0.93	<.001
Income/capita	1616.86	796.98	1982.54	858.48	<.001
Education	3.76	1.66	3.23	1.73	<.001

associated with better well-being. An exception was health care, which correlated negatively with SRH. Fisher's r-to-z transformation (z-test) was used to investigate whether the correlations for the older adults differed from those for the younger adults. The main difference was that the associations between consumption and well-being were stronger among the older than younger adults.

Associations between Leisure Consumption and well-Being Dimensions among Older Adults

In order to find out how spending on leisure predicted the three measurements of well-being in older adults, multiple regressions were performed. The results are presented in Table 4 along with the results for younger adults. After adjusting for age, gender, education, and income, higher levels of expenditure on travel and appearance, and lower levels of expenditure on health care, were related to higher levels of EmWB. Higher expenditure on literature & culture and travel were associated with better EcWB. Higher expenditure on exercise and travel, and lower expenditure on health care, were linked to better SRH.

How Do Older Adults Differ from Younger Adults?

Regression analyses were conducted for both the older and younger age groups (Table 4). The younger group was included to ascertain whether the associations were specific to older adults. The results showed a number of differences between the younger and older age groups in the leisure consumption and well-being measurements. Spending on appearance was associated with EmWB only among the older adults. Spending on technology and indulgence were linked to EcWB in the younger, but not older adults, and high expenditure on appearance was related to SRH in the younger adults, as compared to travel in the older adults. The models seemed to explain less of the variance of well-being among the younger than older adults. The final models explained 4 % vs. 10 % of EmWB, 26 % vs. 31 % of EcWB, and 17 % vs. 23 % of SRH in the younger and older adults, respectively.

Table 3 Correlations between the leisure consumption and well-being variables in the younger (n = 704) and older (n = 661) participants

	EmWB		EcWB		SRH	
	18–49 y.	50–74 y.	18–49 y.	50–74 y.	18–49 y.	50–74 y.
Technology	.01 [a]	.10*	.23***	.25***	-.05 [a]	.08*
Indulgence	.05 [a]	.15***	.24*** [a]	.33***	.09* [a]	.22***
Literature&culture	.09* [a]	.20***	.21*** [a]	.38***	.09* [a]	.18***
Appearance	.11**	.17***	.27***	.28***	.13**	.18***
Travel	.14***	.22***	.35***	.41***	.12** [a]	.25***
Exercise	.14***	.15***	.24***	.22***	.21***	.28***
Health care	-.00	-.05	.08*	.00	-.17*** [a]	-.28***

[a] Significant difference between age groups in correlation, $p < .05$, z-test *$p < .05$, **$p < .01$, ***$p < .001$

*$p < .05$, **$p < .01$, ***$p < .001$

Table 4 Regression analyses on the well-being measurements for the younger (n = 558) and older adults (n = 760), and their interactions

	Emotional well-being (LR)				Economic well-being (LR)			Self-rated health (OR)	
	18–49	50–74	18–74	18–74	18–49	50–74	18–74	18–49	50–74
Technology	-.01	-.07	-.03	-.04	.10*	-.04	.04	.89	.92
Indulgence	-.05	.03	-.07	-.02	.11*	.07	.07*	.96	1.16
L&C	.00	.05	.04	.04	-.02	.11*	.01	1.04	.99
Appearance	.02	.11*	.06	-.00	.07	.06	.06	1.34*	1.33
Exercise	.10*	.06	.07*	.07*	.08	.05	.06*	1.46**	1.53**
Travel	.14**	.12*	.12**	.12***	.14**	.16**	.14**	1.18	1.20*
Health care	-.11*	-.10*	-.11***	-.11***	-.06	-.04	-.05	.56***	.46**
Age[a]	.04	.03	.01	.01	.11**	.02	-.03	.99	1.02
Gender	.03	.09*	.06*	.06*	.03	.02	.03	.74[b]	.74[b]
Education	.09	.03	.06	.06	.11**	.12**	.11**	1.13*	1.09
Income/capita	.01	.14**	.08**	.09**	.26**	.30**	.29**	1.00	1.00
Interactions									
Age[a]*Indulgence			.09*						
Age[a]*Appearance				.09*					
Age[a]*L&C							.05		
Adj. R^2	.04	.10	.09		.26	.31	.28	.17[c]	.23[c]

All models $p \leq .001$

*$p < .05$, **$p < .01$, *** $< .001$. LR = Linear regression, standardized β coefficient presented. OR = Ordinal regression, odds ratios presented. L&C = Literature & culture

[a] Age is a continuous variable in the models for age groups 18–49 and 50–74, and a dichotomous variable in the interaction models

[b] Reference group (1.00) women

[c] Nagelkerke R^2

We also investigated whether the interaction terms calculated between the age and leisure consumption variables were significantly related to different indicators of well-being. The interaction terms between age and indulgence, and age and appearance, were related to EmWB, and that between age and literature & culture was related to EcWB (Table 4). In the models with all the leisure consumption variables and control variables, the interaction terms between age and indulgence and age and appearance remained significant for EmWB, whereas the interaction term between age and literature & culture in relation to EcWB did not. As shown in Figures 1 and 2, high expenditure on indulgence and appearance were related to higher EmWB in older adults than younger adults.

Differences within Older Adults

We investigated whether age or life situation would modify the associations between leisure consumption and well-being (Table 5). We started with age: the group of older adults was subdivided into two classes: older middle-aged (50–61 years) and young

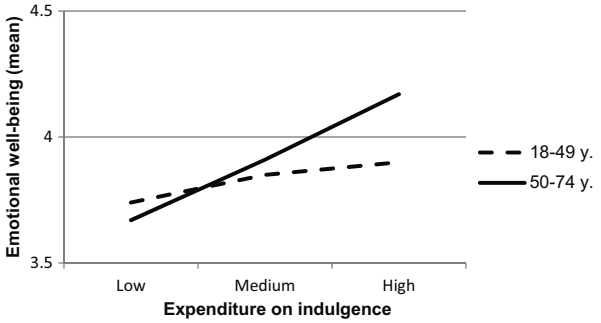

Fig. 1 Interaction effect between expenditure on indulgence and age on emotional well-being (n = 1307)

olds (62–74 years). Four significant interaction effects were found: age in interaction with literature & culture was related to EmWB, age in interaction with indulgence was associated with both EmWB and SRH, and age in interaction with travel was linked to SRH. Of these, two also remained significant in the final models: the interaction terms between age and literature & culture for EmWB and between age and travel for SRH. These two interaction effects, which were stronger in the older middle-aged than young olds, are presented in Figs. 3 and 4.

The moderator role of life situation was tested using employment status, marital status and area of residence as moderators. The interaction term calculated between employment status and health care was significantly associated with EmWB. In the final model, containing all the leisure consumption variables and control variables, it was no longer significant. The interaction terms between employment status and both indulgence and exercise were significantly related to EcWB. However, in the final models only the interaction term between employment status and exercise remained significant (Fig. 5). The interaction term between marital status and exercise was related to SRH. This interaction term also remained statistically significant in the final models, and is shown in Fig. 6. As can be seen in Figs. 5 and 6, low expenditure on exercise was associated with lower EcWB among the retired older adults than working older adults, while older adults living without a partner reported worse SRH than older adults living with a partner. When expenditure on exercise was high, there were no differences between the groups.

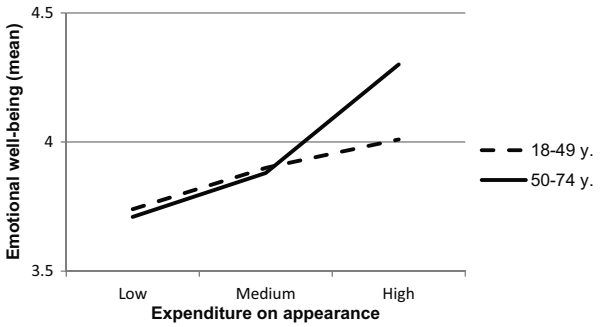

Fig. 2 Interaction effect between expenditure on appearance and age on emotional well-being (n = 1307)

Table 5 Regression analyses on well-being measurements for older adults (n = 760)

	Emotional well-being (LR)			Economic well-being (LR)		Self-rated health (OR)		
Technology	-.06	-.06	-.09	-.07	-.07	.97	.98	.94
Indulgence	.04	.11	.04	.07	.01	1.27	1.14	1.13
L&C	.15*	.04	.04	.08	.09	.98	.98	.1.01
Appearance	.11*	.10	.11*	.07	.07	1.23	1.24	1.25*
Exercise	.07	.06	.06	-.05	.05	1.58***	1.59***	2.13***
Travel	.11*	.11*	.11*	.16***	.17***	1.22*	1.45**	1.22*
Health care	-.10*	-.10*	.01	-.03	-.03	.48***	.48***	.48***
Gender	.09*	.09*	.09*	.02	.02	.72[b]	.72*[b]	.71*[b]
Education	.04	.04	.02	.11**	.11**	1.10	1.10	1.08
Income/capita	.14**	.14*	.12**	.27***	.26***	1.00	1.00	1.00
Age[a]	.07	.05	.16*	.20***	.20***	.72[b]	.69*[b]	1.02
ES			-.16*	-.25***	-.24***			
MS								.81[b]
Interactions								
Age[a]*L&C	-.16**							
Age[a]*Indulgence		-.09				.82		
Age[a]*Travel							.70*	
ES*Health care			-.13					
ES*Exercise				.14*				
ES*Indulgence					.08			
MS* Exercise								.64**
Adj. R^2	.11	.11	.11	.34	.34	.24 [c]	.24[c]	.24[c]

LR Linear regression, standardized β coefficients presented, *OR* Ordinal regression, odds ratios presented, *L&C* Literature & culture, *ES* Employment status, *MS* Marital status

*p < .05,**p < .01, ***p < .001

[a] Age is a dichotomous variable (50–61, 62–74) in the models including age interactions and a continuous variable in the other models

[b] Reference groups (1.00) are: female gender, age 62–74, living with a partner

[c] Nagelkerke R^2

Discussion

This study investigated the associations between different kinds of leisure consumption and different dimensions of well-being in older adults (50- to 74-year-olds). In general, the results revealed some significant associations, for the most part in line with our expectations. Spending on travel was associated positively with all the dimensions of well-being. This supports previous research findings, where spending on travel (DeLeire and Kalil 2010) and experiences (Van Boven and Gilovich 2003) have been associated with better well-being. The association between exercise and physical well-being is also in line with previous findings (e.g. Penedo and Dahn 2005; Galan et al. 2010). At the same time it was somewhat surprising that, in contrast to previous research (e.g. Penedo and Dahn 2005),

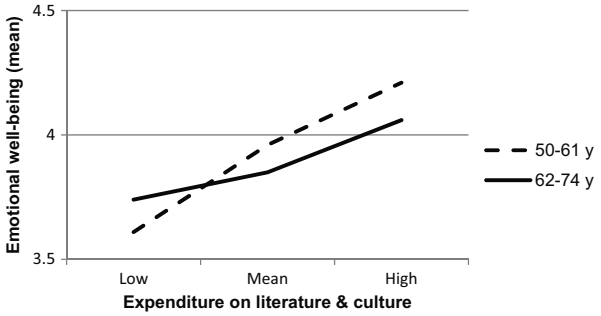

Fig. 3 Interaction effect between expenditure on literature & culture and age on emotional well-being (n = 575)

exercise was not linked to mental well-being. Higher expenditure on health care was associated with lower mental and physical well-being. This is understandable, if health care is mainly understood as medical treatment. Economic well-being, in turn, was linked to spending on travel and on literature & culture. While on the one hand, cultural consumption and travelling may enhance a sense of economic well-being, on the other hand these may be important objects of consumption only if economic resources are good. In summary, the results of this study support the idea that different kinds of leisure consumption are associated with different dimensions of well-being. It is important to note that, according to the present findings, not all kinds of leisure consumption are related to well-being. For example, spending on technology or indulgence was not associated with any dimension of well-being among the older adults. This supports Brown et al. (2015), who found that only active, not passive, leisure activities were linked to better well-being. Elliot et al. (2014) also reported that use of technology was not associated with well-being among older adults. These results are also reasonable in light of the livability theory (Veenhoven and Ehrhardt 1995) and former findings on consumption and subjective well-being (Headey et al. 2008; DeLeire and Kalil 2010), according to which it is not leisure consumption itself that contributes to well-being, but the content and quality of leisure.

To find out whether these associations were age-specific, we compared them with the associations observed for younger adults. The results indicate that the most notable difference between the two age groups is that the associations between leisure consumption and well-being were stronger in the older adults. The results also suggest that

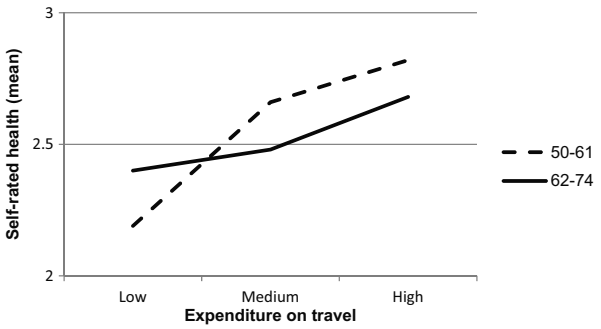

Fig. 4 Interaction effect between expenditure on travel and age on self-rated health (n = 571)

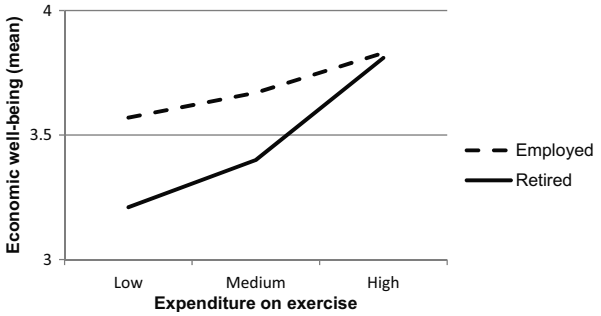

Fig. 5 Interaction effect between expenditure on exercise and employment status on economic well-being (n = 531)

some associations are age-specific to older adults. Particularly surprising is that spending on appearance was linked to better mental well-being only among the older adults, despite the common assumption that younger adults are more interested in fashion and have more materialistic values than older ones (e.g. Valkeneers and Vanhoomissen 2012). The results are in line with the assumptions of the socioemotional selectivity theory (Carstensen et al. 1999) in that for older adults positive feelings were important for well-being while for younger adults the acquisition of new knowledge was associated with well-being. Older adults, however, may also seek pleasure by spending on clothes, interior decoration or beauty care. It has been proposed that different objects of consumption are related to well-being at different life stages (DeLeire and Kalil 2010); this study partially supports this idea. However, some associations, such as those between exercise and physical well-being, and travel and emotional well-being, seem to be common to all age groups.

The second interest of this study was to find out whether differences in relation to leisure consumption and well-being exist among older adults. The associations between cultural consumption and mental well-being, and between travel and physical well-being were stronger among the older middle-agers than young olds. It is possible that if older middle-agers still have children at home and are engaged in working life, then spending time with literature and culture or travelling may, by giving them a chance to relax, enhance their well-being. However, the only difference between retired and employed older adults was that low expenditure on exercise was associated with low economic well-being among the retired older adults. Consequently, the differences between the two age groups are not a result of employment status. Furthermore, the

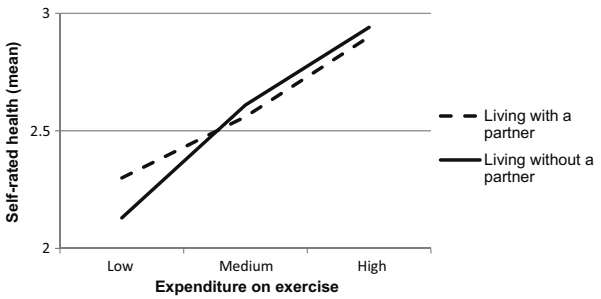

Fig. 6 Interaction effect between expenditure on exercise and marital status on self-rated health (n = 571)

results of this study do not strongly support the notion that associations between leisure and well-being are stronger among retired people (Kuykendall et al. 2015). Of the other issues related to life situation, the only significant difference between the groups was that expenditure on exercise was more strongly associated with physical well-being among unpartnered than partnered older adults. This is in line with findings of Wang et al. (2011), which suggest that exercise has a preventive impact on depression, especially among divorced, separated and widowed women. In general, single middle-aged and older adults have poorer health than their married counterparts (Robards et al. 2012); hence the health-promoting impact of exercise may be more important to them. Area of residence did not show any moderator effects.

The present results have to be interpreted cautiously, first, because they were based on cross-sectional data. Consequently, it is not possible to draw any conclusion about the causal relationships between leisure consumption and well-being, that is, whether leisure consumption improves well-being, or whether well-being enhances leisure consumption. For example, lower expenditure on health care hardly improves well-being, but it is more likely a consequence than an cause of weak well-being. Further, the associations may be bidirectional, so that consumption and well-being form mutual cycles. Second, it may be speculated whether consumption is a valid measurement of leisure, or whether it only informs about the economic resources available for leisure consumption. We shall return to this point when considering the strengths of the study.

Third, it is important to consider the meaning of the different consumption factors. For instance, the factors under "indulgence" comprised spending on self-pampering, having fun/socializing and alcohol. For some people, this type of consumption means spending time with friends and taking time out for oneself, which may contribute to well-being. For others it means heavy drinking and behaving irresponsibly, which may be detrimental to well-being. Similarly, spending on health care may mean different things to different people. For some, it may be restricted to the obligatory costs of medical care, whereas for others it may mean investing in a healthy lifestyle. Hence spending on specific items may have different meanings for different persons.

Fourth, the groups for this study were formed with rather broad age ranges. This is evident in the comparison between younger and older adults, where the age range of the younger adults (18–49 years) was particularly wide. However, because the main interest was in older adults, and younger adults were only used as a comparison group, we did not see any necessity to divide them into smaller groups. A similar age grouping has been used previously; for example, Toepoel (2013) compared older adults (aged 55+) with younger adults (18–54 years). In this study, age was also controlled for as a continuous variable in the analyses.

Notwithstanding the limitations of the present study, it has several strengths. First, it was based on a relatively large, randomized sample size of individuals representing the Finnish adult population. Therefore the results can be generalized to the Finnish adult population aged 18–74. Second, different kinds of leisure consumption have not previously been compared in relation to well-being, and particularly in relation to different dimensions of well-being. Hence, the findings of the present study broaden the existing knowledge on leisure consumption and well-being. Third, although economic resources clearly have some impact on leisure consumption, the present results are largely consistent with previous results on leisure and well-being. This validates the usefulness of consumption as a measure of leisure activities. We also controlled the

analyses for income per consumption unit, and hence the associations between leisure consumption and well-being are not solely a consequence of economic resources.

In conclusion, our results showed that leisure consumption and well-being are linked, and the associations vary by the dimensions of well-being, age and life situation. Leisure consumption may function as an indicator of an individual's leisure preferences. In general, the associations of leisure consumption with well-being were stronger among the older than the younger adults, implying that when people have fewer time constraints they invest in leisure activities that maintain their well-being. The results showed that among the older adults whose expenditure on exercise was low, economic well-being was lower among the retired than among the employed. It is possible that, among employed older adults, time is the most important constraint on exercise, while among retired older adults it is financial. Hence, free and low-priced leisure time activities should also be available to older adults so as to reduce the importance of material resources for the well-being of this population segment. Furthermore, older adults should not be regarded as a homogenous age group, and thus leisure activities should be considered more broadly and in a more individual way. In the future, it would be important to replicate our findings by applying a multidisciplinary perspective in order to link leisure consumption and well-being with each other. It would further be important to consider well-being as a multidimensional construct. Finally, future research would benefit from longitudinal research designs which would make it possible to obtain information about the causal relations between leisure and well-being.

Acknowledgments The authors wish to thank staff at the Unit of Economic Sociology at the University of Turku, Finland, for the data collection.

Compliance with Ethical Standards

Funding The research was carried out with financial support from Tekes – the Finnish Funding Agency for Innovation. Project number: 2826/31/2014.

Conflict of Interest The authors declare no conflict of interest.

Human Participants The data for this study were collected by a mail survey. All participants received information about use of the data by covering letter and participated voluntarily in the study.

References

Adams, K. B., Leibbrandt, S., & Moon, H. (2011). A critical review of the literature on social and leisure activity and wellbeing in later life. *Ageing and Society, 31*(04), 683–712.

Aro, R., & Wilska, T.-A. (2014). Standard of living, consumption norms, and perceived necessities. *International Journal of Sociology and Social Policy, 34*(9), 710–728.

Brajša-Žganec, A., Merkaš, M., & Šverko, I. (2011). Quality of life and leisure activities: How do leisure activities contribute to subjective well-being? *Social Indicators Research, 102*(1), 81–91.

Brown, J., MacDonald, R., & Mitchell, R. (2015). Are people who participate in cultural activities more satisfied with life? *Social Indicators Research, 122*(1), 135–146.

Bryman, A. (2004). *The Disneyization of Society*. London: Sage Publications.

Capio, C., Sit, C. P., & Abernethy, B. (2014). Physical well-being. In A. Michalos (Ed.), *Encyclopedia of quality of life and well-being research* (pp. 4805–4807). Netherlands: Springer.

Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). Taking time seriously. A theory of socioemotional selectivity. *The American Psychologist, 54*(3), 165–181.

Christoph, B. (2010). The relation between life satisfaction and the material situation: A re-evaluation using alternative measures. *Social Indicators Research, 98*(3), 475–499.

Dawson, J. (2014). Moderation in management research: What, why, when, and how. *Journal of Business and Psychology, 29*(1), 1–19.

DeLeire, T., & Kalil, A. (2010). Does consumption buy happiness? evidence from the United States. *International Review of Economics, 57*(2), 163–176.

Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). Subjective well-being: Three decades of progress. *Psychological Bulletin, 125*(2), 276–302.

Diener, E. (2006). Guidelines for national indicators of subjective well-being and ill-being. *Applied Research in Quality of Life, 1*(2), 151–157.

Dodge, R., Daly, A. P., Huyton, J., & Sanders, L. D. (2012). The challenge of defining wellbeing. *International Journal of Well-being, 2*(3), 222–235.

Dolan, P., Peasgood, T., & White, M. (2008). Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective well-being. *Journal of Economic Psychology, 29*(1), 94–122.

Dunn, E. W., Gilbert, D. T., & Wilson, T. D. (2011). If money doesn't make you happy, then you probably aren't spending it right. *Journal of Consumer Psychology, 21*(2), 115–125.

Easterlin, R. A. (2002). Rich and poor: Disparities, perceptions, concomitants. In W. Glatzer (Ed.), (pp. 157–175). Dordrecht: Springer Netherlands.

Elliot, A. J., Mooney, C. J., Douthit, K. Z., & Lynch, M. F. (2014). Predictors of older adults' technology use and its relationship to depressive symptoms and well-being. *The Journals of Gerontology: Series B: Psychological Sciences and Social Sciences, 69B*(5), 667–677.

Eriksson, I., Undén, A., & Elofsson, S. (2001). Self-rated health. comparisons between three different measures. results from a population study. *International Journal of Epidemiology, 30*(2), 326–333.

Foster, A. C. (2015). Consumer expenditures vary by age. *Beyond the Numbers: Prices & Spending, 4*(14) Washington: U.S. Bureau of Labor Statistic.

Galan, I., Meseguer, C. M., Herruzo, R., & Rodriguez-Artalejo, F. (2010). Self-rated health according to amount, intensity and duration of leisure time physical activity. *Preventive Medicine, 51*(5), 378–383.

Gouveia, V. V., Vione, K. C., Milfont, T. L., & Fischer, R. (2015). Patterns of value change during the life span: Some evidence from a functional approach to values. *Personality and Social Psychology Bulletin, 41*(9), 1276–1290.

Hagger-Johnson, G. (2014). *Introduction to research methods and data analysis in the health sciences*. New York: Routledge.

Halleröd, B., & Seldén, D. (2013). The multi-dimensional characteristics of wellbeing: How different aspects of wellbeing interact and do not interact with each other. *Social Indicators Research, 113*(3), 807–825.

Halleröd, B., Larsson, D., Gordon, D., & Ritakallio, V. (2006). Relative deprivation: A comparative analysis of Britain, Finland and Sweden. *Journal of European Social Policy, 16*(4), 328–345.

Hamilton, K. (2009). Low-income families: Experiences and responses to consumer exclusion. *International Journal of Sociology and Social Policy, 29*(9), 543–557.

Headey, B., Muffels, R., & Wooden, M. (2008). Money does not buy happiness: Or does it? A reassessment based on the combined effects of wealth, income and consumption. *Social Indicators Research, 87*(1), 65–82.

Hietalahti, M., Rantanen, J., & Kokko, K. (2016). Do life goals mediate the link between personality traits and mental well-being? *The Journal of Happiness & Well-being, 4*, 72–89.

Hudders, L., & Pandelaere, M. (2012). The silver lining of materialism: The impact of luxury consumption on subjective well-being. *Journal of Happiness Studies, 13*(3), 411–437.

IBM Corp (2013). *IBM SPSS statistics for windows, version 22.0.* Armonk, NY: IBM Corp.

Idler, E. L., & Benyamini, Y. (1997). Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior, 38*(1), 21–37.

Joo, S. (2008). Personal financial wellness. In J. J. Xiao (Ed.), *Handbook of consumer finance research* (pp. 21–34). New York: Springer.

Katz-Gerro, T. (2004). Cultural consumption research: review of methodology, theory, and consequence. *International Review of Sociology, 14*(1), 11–29.

Keyes, C. L. M. (1998). Social well-being. *Social Psychology Quarterly, 61*, 121–140.

Koivula, A., Räsänen, P., & Sarpila, O. (2015). *Working papers in economic sociology: Suomi 2014 – kulutus ja elämäntapa: Tutkimusseloste ja aineistojen 1999–2014 vertailua*. Turku: University of Turku.

Kokko, K., Tolvanen, A., & Pulkkinen, L. (2013). Associations between personality traits and psychological well-being across time in middle adulthood. *Journal of Research in Personality, 47*(6), 748–756.

Kuykendall, L., Tay, L., & Ng, V. (2015). Leisure engagement and subjective well-being: A meta-analysis. *Psychological Bulletin, 141*(2), 364–403.

Le Roux, B., Rouanet, H., Savage, M., & Warde, A. (2008). Class and cultural division in the UK. *Sociology, 42*(6), 1049–1071.

Leadbetter, C., & O'Connor, N. (2013). *Healthy attendance? The impact of cultural engagement and sports participation on health and satisfaction with life in Scotland.* Edinburgh: Scottish Government Social Research. ISBN: 978–1–78256-790-5

Lee, J. H., Lee, J. H., & Park, S. H. (2014). Leisure activity participation as predictor of quality of life in Korean urban-dwelling elderly. *Occupational Therapy International, 21*(3), 124–132.

Miles, S. (1998). *Consumerism - as a way of life*. London: Sage Publications.

Moschis, G. P. (2012). Consumer behavior in later life: current knowledge, issues, and new directions for research. *Psychology and Marketing, 29*(2), 57–75.

OECD. (2009). Special focus: Measuring leisure in OECD countries. *Society at a Glance 2009: OECD Social Indicators* Paris: OECD pp 19-49

Official Statistics of Finland (2012). *Households' consumption [e-publication]*. Statistics Finland: Helsinki.

Official Statistics of Finland. (2011). Time use survey [e-publication]. Changes 1979–2009. Helsinki: Statistics Finland.

Penedo, F. J., & Dahn, J. R. (2005). Exercise and well-being: A review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry, 18*(2), 189–193.

Ritzer, G. (2010). *Enchanting a Disenchanted World: Continuity and Change in the Cathedrals of Consumption* (3rd ed.). New York: SAGE Publications.

Robards, J., Evandrou, M., Falkingham, J., & Vlachantoni, A. (2012). Marital status, health and mortality. *Maturitas, 73*(4), 295–299.

Ryan, R. M., & Deci, E. L. (2001). On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology, 52*, 141–166.

Sassatelli, R. (2007). *Consumer culture: history, theory and politics*. London: Sage Publications.

Schwartz, S. H. (2012). Online Readings in Psychology and Culture, 2(1), 1–20.

Schwartz, S. H. (2006). Basic human values: theory, measurement, and applications. *Revue Française De. Sociologie, 47*(4), 249–288.

Segal, B., & Podoshen, J. S. (2013). An examination of materialism, conspicuous consumption and gender differences. *International Journal of Consumer Studies, 37*(2), 189–198.

Sewo Sampaio, P. Y., Ito, E., & Sampaio, R. A. C. (2013). The association of activity and participation with quality of life between Japanese older adults living in rural and urban areas. *Journal of Clinical Gerontology and Geriatrics, 4*(2), 51–56.

Sheldon, K. M., & Elliot, A. J. (1999). Goal striving, need satisfaction, and longitudinal well-being: The self-concordance model. *Journal of Personality and Social Psychology, 76*(3), 482–497.

Smith Maguire, J. (2008). *Fit for consumption: sociology and the business of fitness*. London: Routledge.

Stevens, J. P. (2009). Exploratory and confirmatory factor analysis. 5th ed. *Applied multivariate statistics for the social sciences* (pp. 325–394). Hillsdale, NJ: Routledge.

Taylor, L. (2002). From ways of life to lifestyle: the `Ordinari-ization'of British gardening lifestyle television. *European Journal of Communication, 17*(4), 479–493.

Toepoel, V. (2013). Ageing, leisure, and social connectedness: how could leisure help reduce social isolation of older people? Social Indicators Research, 113(1), 355–372.

Valkeneers, G., & Vanhoomissen, T. (2012). Generations living their own life: The differences in lifestyle and consumer behaviour between busters and baby boomers. *Journal of Customer Behaviour, 11*(1), 53–68.

Van Boven, L., & Gilovich, T. (2003). To do or to have? that is the question. *Journal of Personality and Social Psychology, 85*(6), 1193–1202.

Veenhoven, R., & Ehrhardt, J. (1995). The cross-national pattern of happiness: Test of predictions implied in three theories of happiness. *Social Indicators Research, 34*(1), 33–68.

Wang, F., DesMeules, M., Luo, W., Dai, S., Lagace, C., & Morrison, H. (2011). Leisure-time physical activity and marital status in relation to depression between men and women: A prospective study. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association, 30*(2), 204–211.

Wheaton, B. (2010). Introducing the consumption and representation of lifestyle sports. *Sport in. Society, 13*(7–8), 1057–1081.

Windsor, T. D., & Anstey, K. J. (2010). Age differences in psychosocial predictors of positive and negative affect: A longitudinal investigation of young, midlife, and older adults. *Psychology and Aging, 25*(3), 641–652.

Wu, S., Wang, R., Zhao, Y., Ma, X., Wu, M., Yan, X., & He, J. (2013). The relationship between self-rated health and objective health status: A population-based study. *BMC Public Health, 13*(320), 2458–13-320.

Yoon, C., Cole, C. A., & Lee, M. P. (2009). Consumer decision making and aging: Current knowledge and future directions. *Journal of Consumer Psychology, 19*(1), 2–16.

II

CROSS-SECTIONAL AND LONGITUDINAL ASSOCIATIONS BETWEEN LEISURE TIME PHYSICAL ACTIVITY, MENTAL WELL-BEING AND SUBJECTIVE HEALTH IN MIDDLE ADULTHOOD

by

Kekäläinen T., Freund A.M, Sipilä S, Kokko K.

Submitted for publication.

Cross-sectional and Longitudinal Associations between Leisure Time Physical Activity, Mental Well-Being and Subjective Health in Middle Adulthood

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Acknowledgements
The authors appreciate Professor Lea Pulkkinen's contribution to the Jyväskylä Longitudinal Study of Personality and Social Development over the years. This study was presented at the Gerontological Society of America Annual Scientific Meeting in Boston, USA, November 2018.
Funding: The most recent JYLS data collection in 2009 was funded by the Academy of Finland through grants Nos. 127125 and 118316. This work was supported by a personal grant to Tiia Kekäläinen from the Finnish Cultural Foundation.
Compliance with Ethical Standards: Informed consent was obtained from all individual participants included in the study.
Conflict of Interest: The authors declare that they have no conflict of interest.

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Abstract

Previous studies have shown that participation in leisure time physical activity is related to better mental well-being and subjective health. However, the associations between different types of leisure time physical activities and different dimensions of mental well-being have rarely been studied. In addition, longitudinal research, analyzing possible causal relations between these variables, is lacking. To investigate these research questions, data gathered at ages 42 and 50 (present N=303) for the Finnish Jyväskylä Longitudinal Study of Personality and Social Development were used. Physical activity was assessed as frequency of participation at ages 42 and 50, and at age 50 also as frequency of participation in different types of physical activities. Mental well-being was captured by emotional, psychological and social well-being and subjective health by self-rated health and symptoms. Cross-sectionally, different types of physical activities were related to different dimensions of well-being. Walking had positive associations with psychological and social well-being, rambling in nature with emotional and social well-being, and endurance training with subjective health. Rambling in nature was also positively related to subjective health but only among men. Longitudinally, mental well-being predicted later participation in leisure-time physical activity, whereas no longitudinal associations between subjective health and physical activity were found. The results suggest that leisure time physical activities are related to current mental well-being and subjective health in midlife. Across time, good mental well-being seems to be a resource promoting engagement in physical activity.

Keywords: Physical activity, exercise, well-being, midlife

1 Introduction

1.1 The Concept of Well-Being in This Study

The term well-being is often used in the psychological literature but is defined in different ways in different research traditions. Here, we refer to well-being as a subjective experience and conceptualize it using the tripartite model proposed by Keyes (2005), according to which mental well-being is not understood simply as the absence of ill-being (Keyes 2005; Ryan & Deci 2001; Seligman 2008). Instead, individuals with high well-being are flourishing and have high levels of emotional, psychological and social well-being (Keyes 2005). Emotional well-being describes an individual's emotional states and cognitive evaluation of satisfaction with life, including the presence of positive feelings, absence of negative feelings and overall perceived satisfaction with life (Keyes 2005). Psychological well-being indicates positive functioning in six domains: self-acceptance, positive relations with others, personal growth, purpose in life, environmental mastery and autonomy (Ryff 1989). Social well-being, measured along the dimensions of coherence, actualization, integration, acceptance and contribution, indicates how well an individual is functioning as a part of society and in meeting social challenges (Keyes 1998). Here, in line with other research based on the same Finnish JYLS data (Kokko, Korkalainen, Lyyra, & Feldt 2013; Kokko, Rantanen, & Pulkkinen 2015), we use the term mental well-being as defined in the Keyes' tripartite model (Keyes 2005).

Because leisure time physical activity (LTPA) has both mental and physical benefits (McAuley & Rudolp 1995; Netz, Wu, Becker, & Tenenbaum 2005; Newman, Tay, & Diener 2014), as well as applying the tripartite model of mental well-being, subjective health is also investigated in this study. Subjective health includes the absence of bothersome symptoms but, like mental well-being, it is not merely the absence of ill-being: subjective health also has a positive side, manifested in experiences such as a sense of energy,

vitality and overall physical well-being (Seligman 2008). In the present study, we include self-rated health and symptoms as indicators of subjective health (Kinnunen, Kokkonen, Kaprio, & Pulkkinen 2005).

1.2 Leisure Time Physical Activity and Well-Being

Leisure is one of the life domains considered central for overall well-being (Diener, Suh, Lucas, & Smith 1999; Nawijn & Veenhoven 2013). Nowadays, when most jobs are sedentary, LTPA plays a key role in the recuperation of both mind and body. Sedentary leisure behavior is negatively associated with mental well-being and subjective health outcomes (deRezende, Rodrigues Lopes, Rey-López, Matsudo, & Luiz 2014; Hamer, Stamatakis, & Mishra 2010), while numerous previous studies conducted in different fields have shown a positive association of LTPA with mental well-being and health among different age groups, including middle-aged adults (Brown, Mishra, Lee, & Bauman 2000; Holstila, Mänty, Rahkonen, Lahelma, & Lahti 2017; Lahti et al. 2016; Penedo & Dahn 2005; Södergren, Sundquist, Johansson, & Sundquist 2008; Sonnentag 2003; Wiese, Kuykendall, & Tay 2018). The possible reasons why LTPA contributes to mental well-being and subjective health include, physical benefits, mastery experiences gained during exercise, positive experiences of recovery and relaxation, and social interaction (McAuley & Rudolp 1995; Netz et al. 2005; Newman et al. 2014).

Previous studies have mainly focused on general LTPA. However, different types of LTPA have different general characteristics, such as where (outdoor vs. indoor), with whom (social vs. solitary), and how intensively (more vs. less intensive) they are performed. In addition, different types of LTPA, such as endurance training and gym training, target different physical characteristics (Garber et al. 2011) and may, therefore, also have different psychological benefits. Previous reviews have shown that both endurance and resistance training are related to mental well-being among adults in all age groups (O'Connor, Herring, & Caravalho 2010; Penedo & Dahn 2005). In addition, cross-sectional studies have consistently found positive associations between different types of LTPA (e.g. walking, outdoor and

indoor activities) and mental well-being or subjective health among different adult age groups (Chang, Lin, & Song 2018; Oh et al. 2017; Pietilä et al. 2015).

Some studies have also found differences between different types of LTPA in relation to well-being. A study comparing adults' (age 20-65) favorite types of sports and perceived stress levels found some differences between individuals' LTPA preferences: for example, among women, those who preferred walking or meditation perceived higher levels of stress than those who preferred other types of LTPA, such as biking, fitness or dance, and among men, those who preferred ball games perceived lower levels of stress than those who preferred other types of LTPA (Asztalos et al. 2012). There is also some evidence from samples of young adults and of adults in general of higher well-being among those who participate in team sports or sport clubs than those who participate in individual LTPA (Andersen, Ottesen, & Thing 2018; Doré, O'Loughlin, Beauchamp, Martineau, & Fournier 2016; Eime, Harvey, Brown, & Payne 2010). Intensity has shown a linear relationship with subjective health (Galan, Meseguer, Herruzo, & Rodriguez-Artalejo 2010), although among adults, including the middle-aged, light or moderate intensity LTPA may have a stronger relationship with mental well-being than vigorous LTPA (Holstila et al. 2017; Panza, Taylor, Thompson, White, & Pescatello 2017). Additionally, the associations of LTPA with mental well-being and subjective health may vary: a study among Australian national park visitors showed that while walkers, hikers and runners in all age groups (age 18+) reported that visiting a national park increased their mental well-being and subjective health, the increase in mental well-being was greater than the increase in subjective health for the walkers and hikers (Wolf & Wohlfart 2014). However, different types of LTPA and different dimensions of mental well-being or subjective health have rarely been studied within the same study; hence, more information on this topic is needed.

There is also evidence that the associations between LTPA and well-being vary by gender: for example, in the above-cited study among Australian national park visitors, women experienced greater improvements in well-being than men during their park visit (Wolf & Wohlfart 2014). In addition, mild LTPA, such as walking, was related to better well-being in women aged 25-64 years whereas more intensive LTPA showed the same association in same-age men (Asztalos, De Bourdeaudhuij, & Cardon 2010). Men and women also differ in their LTPA behavior; in Finland, for example, the physical activity guidelines for aerobic activity were met more often by women while the strength training guidelines were met more often by men (Bennie et al. 2017). It is, therefore, important not to neglect possible gender differences when studying the associations between different types of LTPA and well-being. Moreover, gender differences in the associations of different types of LTPA with well-being have not previously been studied among middle-aged people.

Despite the consistent evidence of a relationship between LTPA and well-being, the longitudinal associations remain unclear (Wiese et al. 2018). Intervention studies have shown physical exercise to be an effective way to increase well-being (Mikkelsen, Stojanovska, Polenakovic, Bosevski, & Apostolopoulos 2017), whereas observational longitudinal studies have shown inconsistent results. For example, Xu et al. (2010) found that a higher level of LTPA was related to better current mental well-being only and did not predict mental well-being five years later among Australian middle-aged and older women, whereas Blomstrandt et al. (2009) found that a higher level of LTPA predicted better mental well-being up to 24 years later among Swedish middle-aged women. In contrast, Lahti et al. (2016), in their five- to seven-year follow-up study, found a link between a higher level of LTPA at baseline and both better mental well-being and better health at follow-up, although in this Finnish middle-aged sample the longitudinal association of LTPA with mental well-being was seen only among women. The focus in these studies has usually been the path from LTPA to mental well-being to the relative neglect of the possible reverse causality from mental well-being to LTPA. As an exception, Steinmo, Hagger-Johnson,

and Shahab (2014) in their ten-year follow-up study of middle-aged men and women revealed bidirectional longitudinal associations between LTPA and mental well-being. However, while participation in LTPA has generally been shown to predict better subjective health (Holstila et al. 2017; Sargent-Cox, Cherbuin, Morris, Butterworth, & Anstey 2014), the reverse, i.e., that subjective health predicts participation in LTPA, has also been reported (Weiss, O'Loughlin, Platt, & Paradis 2007).

In middle adulthood, the time available for leisure is often severely limited by the demands of other life domains, such as work and family (Lachman 2004). In fact, among working mothers, higher dissatisfaction with time resources has been found to be related to higher goal conflict between physically active and physically passive leisure; this, in turn, is related to lower mental well-being (Williams, Guerin, & Fortier 2014). Because of these time demands, LTPA and other leisure activities are important, especially in midlife, as they are related to better recovery experiences and job performance (de Bloom, Rantanen, Tement, & Kinnunen 2018; Sonnentag 2003). Participation in LTPA also buffers against the negative association often found between work-family spillover and subjective health (Lee, B. et al. 2015). In addition to positive current physical and mental benefits (Garber et al. 2011; Wiese et al. 2018), participation in LTPA in midlife holds many benefits for health in older age, such as lower risk for dementia (Rovio et al. 2005), metabolic syndrome (Holme, Tonstad, Sogaard, Larsen, & Haheim 2007) and mobility limitations (Hinrichs et al. 2014; Patel et al. 2006). However, this age group has been largely neglected in well-being research (Lachman, Teshale, & Agrigoroaei 2015).

1.3 Aims of the Study

The purpose of this study was to investigate:

1) the cross-sectional associations between different types of LTPA, dimensions of mental well-being and subjective health at age 50;

2) whether, in cross-lagged longitudinal models, LTPA predicts mental well-being and subjective health, after controlling for stability in these variables from age 42 to 50, or whether, vice versa, mental well-being and subjective health predict LTPA; and
3) whether gender plays a role in these cross-sectional and longitudinal associations.

Based on the literature, we hypothesized:

(H1) that different types of LTPA are positively related to different dimensions of well-being: for example, more intensive activities (e.g. endurance and gym training) are related to subjective health, and less intensive activities (e.g. walking) and social activities (e.g. ball games) to emotional well-being;

(H2) that in the cross-lagged models, where the stability of variables is controlled for, LTPA at age 42 predicts mental well-being and subjective health at age 50; and

(H3) that the associations differ by gender, i.e., that the types of LTPA related to mental well-being differ between women and men

2 Method

2.1. Participants

The data for this study were drawn from the Jyväskylä Longitudinal Study of Personality and Social Development (JYLS) (Pulkkinen 2017). The study started in 1968 with a sample of 12 randomly selected school classes of second-graders (173 girls, 196 boys N=369). Most (93.5%) of the participants were born in 1959 and the remainder in 1958 or 1960, and thus were around eight years old at study outset (Pulkkinen 2017). Since then, the participants have been followed up to age 50 at six- to eight-year intervals.

This study used the data collected in 2001 and 2009 when the participants were 42 and 50 years old, respectively. Information was collected by life situation questionnaires, personal interviews and health examinations. The ethical committee of the Central Finland Health Care District approved the data collection in 2001 and again in 2009. Of the initial sample (N=369), 77% (n=285) at age 42 and 73%

(n=271) at age 50 participated in at least one data collection method (Pulkkinen 2017). The present analyses were restricted to those who had participated in one or both data collection phases (n=303). Of these, 84% (n=253) had participated in both phases. Sample sizes for the variables used in this study ranged between 217 and 284. Participants in the adult data collections were representative both of the initial sample and of their respective Finnish age cohort (Metsäpelto et al. 2010; Pulkkinen 2006).

2.2. Measurements

Leisure time physical activity (LTPA) was measured by a single question at age 42. The same question was also used at age 50 but with supplementaries seeking more detailed information. The question asked at both ages was used in the longitudinal analyses (study question 2): "How often do you take exercise (including incidental exercise) or engage in sports in your leisure time?" The 6-point response scale was 0 = *never*, 1 = *less than once a month*, 2 = *1-2 times/month*, 3 = *once a week*, 4 = *2-3 times/week*, 5 = *4-5 times/week*, 6 = *practically every day*. At age 50, participants were also asked about their frequency of participation in 17 different types of LTPA. The 4-point response scale was 1 = *not at all or very seldom*, 2 = *less frequently than once a month, 3 = once a month to four times a month* and 4 = *twice a week or more frequently.* Activities (e.g. skating and athletics) reported by only a few individuals (fewer than 15% at least once a month) were excluded from this study. The remaining activities were categorized into: 1) *walking,* including walking 3-4 kms at a time, walking 5 kms or more at a time and Nordic walking, 2) *endurance training*, including running, skiing, swimming and biking, 3) *group and team sports*, including ball games and group fitness, 4) *gym training* (a single question, recoded as 0 = less than once a month, 1= at least once a month) and 5) *rambling in nature* (a single question, recoded as 0=less than once a month, 1=at least once a month). These five categories were used in the cross-sectional analyses (study question 1) and assumed to capture both aerobic training (walking and endurance training) and strength training (gym training) according to general physical activity guidelines (Garber et al. 2011) as well as the benefits of spending time in a natural environment (rambling in nature) and social interaction (group and

team sports). For categories 1-3, mean values were calculated. As it was not assumed that activities in the same category would necessarily correlate with each other, e.g., a participant might participate only in running but not in any type of other endurance training, Cronbach´s alphas were not calculated. The total number of responses to the LTPA questions varied between 214 and 277.

Mental well-being was measured by three dimensions: emotional, psychological and social (Kokko et al. 2015). Emotional well-being included questions about life satisfaction, happiness, positive mood and negative mood (Kokko et al. 2013; Kokko et al. 2015). Participants were asked to rate their satisfaction in seven different domains of life (leisure, housing, financial situation, choice of occupation, present occupational situation, present intimate relationship or lack of one and present friendly relations) on a 4-point response scale from *1 = very unsatisfied* to *4 = very satisfied* (Kokko, Tolvanen, & Pulkkinen 2013). The mean value was calculated and taken to represent overall life satisfaction. Cronbach's alphas were 0.65 and 0.63 at ages 42 and 50, respectively (Kokko et al. 2013). Deleting any items would not have improved the alpha values. Happiness was self-rated with the question "How happy or satisfied have you been at different stages of your life?" (Perho & Korhonen 1993) on a 7-point response scale from *-3 = very unhappy or dissatisfied* to *3 = very happy or satisfied*. The question referred to the age span from 40 to 42 years at age 42 and to current age at 50. Positive mood was self-rated in the interviews with two items ("Happy" and "Satisfied") and negative mood with five items (e.g. "Frightened"; (Kokkonen 2001) from the Brief Mood Introspection Scale (Feldman 1995; Mayer & Gaschke 1988) on a 4-point response scale ranging from *1 = describes my mood not at all* to *4 = describes my mood very well.* Cronbach`s alphas for positive and negative mood were 0.84 and 0.68, respectively, at age 42 (Kokko et al. 2013), and 0.79 and 0.64 at age 50. The response scale for the negative mood items was reversed for further analyses. The emotional well-being indicators were standardized and their mean values calculated. Cronbach´s alphas for emotional well-being were 0.69 at age 42 and 0.75 at age 50. Psychological well-being at ages 42 and 50 was measured with the 18-item shortened form of the Scales of Psychological

Well-being (Ryff 1989), where each of the components of psychological well-being (self-acceptance, positive relationships with others, environmental mastery, autonomy, purpose in life and personal growth) was measured with three items self-rated on a 4-point scale from *1 = strongly disagree* to *4 = strongly agree*. The mean score of the 18 items was computed. Cronbach`s alpha was 0.75 at age 42 and 0.77 at age 50 (Kokko et al. 2013). Social well-being was measured with the 15-item Scales of Social Well-Being (Keyes 1998). Each component of social well-being (integration, acceptance, actualization, coherence and contribution) contains three items self-rated on a 4-point scale from *1 = strongly disagree* to *4 = strongly agree*. The mean score of the 15 items was calculated. Cronbach's alpha was 0.77 at age 42 and 0.79 at age 50 (Kokko et al. 2015). The mean values of emotional, psychological and social well-being were used as indicators of the latent variable of mental well-being. Because life satisfaction was rated in life situation questionnaires and mood, happiness and psychological and social well-being in interviews, the sample sizes for these indicators at each of the two ages differed. Information on at least some of the mental well-being indicators was available for 284 and 269 participants at ages 42 and 50, respectively.

Subjective health was measured at ages 42 and 50 by self-rated health and symptoms (Kinnunen et al. 2005). Self-rated health was asked with the question "What has your state of health been like during the past year?" on a 5-point scale from *1 = excellent* to *5 = extremely poor*. Because at both ages one percent or fewer of the participants evaluated their health as extremely poor (= 5), this category was merged with the adjacent one (4 = fairly poor). The scale was reversed, with higher values representing better self-rated health. Symptoms were measured with 19 psychological and physical symptoms (e.g., headache, stomachache, tiredness and weakness, loss of appetite, and muscular pain) drawn from the Health Symptom Checklist (Aro, Paronen, & Aro 1987). Participants were asked to evaluate how often they had experienced the different symptoms during the last six months on a 4-point scale from *1 = never* to *4 = very often.* Participants were asked not to include symptoms regularly associated with menstruation, pregnancy or hangover. Cronbach's alphas for the scale were 0.83 at age 42 (Kinnunen, Feldt, Kinnunen,

& Pulkkinen 2008) and 0.80 at age 50. For the structural equation modeling, the scale was reversed, with higher values representing a lower frequency of symptoms. Self-rated health and the reverse mean value of symptoms were used as indicators of the latent variable of subjective health (Kinnunen et al. 2005). Information on at least one subjective health indicator was available for 284 participants at age 42 and 267 at age 50.

2.3 Data Analysis

Statistical analyses were performed using IBM SPSS Statistics 24.0 for descriptive statistics and to answer research question 1 and Mplus statistical package version 7.4 (Muthén & Muthén 2017) for structural equation modeling (SEM) (research question 2). For descriptive purposes, cross-sectional and longitudinal correlations between the study variables were analyzed using the Pearson correlation test. Differences in the levels of the variables at ages 42 and 50 were analyzed using the t-test for paired samples and effect sizes for mean-level changes were calculated by dividing the mean difference by the standard deviation. Differences between different groups at the same age were analyzed using ANOVA. Cross-sectional associations between the different types of LTPA, mental well-being and subjective health were analyzed by linear regression. The moderator effect of gender on mental well-being and subjective health was tested by including an interaction terms calculated between the variables for gender and activities. All regression analyses were adjusted by education and marital status.

For the SEM, the full information maximum likelihood estimation method with robust standard error and scale-corrected chi-square value (MLR estimator) with covariance matrices in Mplus was used. As the research interest was not in the mutual links between mental well-being and subjective health, they were tested in separate models. The longitudinal SEM was started by testing the measurement invariance of the latent variables in the models for the two indicators. In addition, measurement invariance for gender was analyzed with multigroup modeling. The longitudinal models included longitudinal paths a) testing

stability over time in LTPA and mental well-being/subjective health (autoregressive paths), b) from LTPA to mental well-being/subjective health, and c) from mental well-being/subjective health to LTPA. LTPA and mental well-being/subjective health at the same measurement points were allowed to correlate. Multigroup modeling was used to test whether these paths differed between men and women.

Model fit was evaluated by the chi-square test, comparative fit index (CFI), root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR). Statistically insignificant ($p>.05$) chi-square test values indicate an acceptable model; CFI values >.95 indicate acceptable fit and values >.97 good fit; RMSEA values between 0.05 and 0.08 indicate adequate fit and values <.05 good fit; and SRMR values ≤.08 indicate acceptable fit (Hooper, Coughlan, & Mullen 2008; Schermelleh-Engel, Moosbrugger, & Müller 2003; Schreiber, Nora, Stage, Barlow, & King 2006).

3 Results

3.1 Descriptive Statistics

Means and standard deviations along with bi-variate correlations between the study variables are presented in Table 1. The correlations between all the study variables for men and women separately are available in Online Supplement 1. The means and standard deviations for subjective health (Kinnunen et al. 2005; Kinnunen et al. 2008), mental well-being indicators at age 42 (Kokko et al. 2013) and psychological well-being at age 50 (Kokko et al. 2013) have been presented earlier. Happiness ($t(df)=-3.19$ (202), $p=.002$; effect size (d) =.22) and social well-being ($t(df)=-6.12$ (199), $p<.001$; $d= .43$) tended to increase over time from age 42 to age 50, as reported earlier (Kokko 2010). The mean level of LTPA also increased from age 42 to age 50 ($t(df)=-3.93(241)$, $p<.001$; $d=.25$).

At age 42, LTPA was not associated with any well-being indicator. At age 50, however, it correlated with the subjective health indicators and with psychological well-being and positive mood. All the different types of LTPA correlated positively with some well-being indicators at age 50, with the exception of group and team sports, which showed no associations with the well-being indicators.

(Table1)

3.2 Cross-sectional Associations between LTPA, Mental Well-Being and Subjective Health

Cross-sectional associations between leisure time physical activities and well-being at age 50 were analyzed by linear regression (Table 2). A separate model for each well-being indicator was conducted. The moderator effect of gender was investigated in regression models that included the main variables (gender and activity) and the interaction term between them. Statistically significant interaction terms were included in the final models containing all activities. All regression analyses were adjusted by education and marital status.

Rambling in nature showed interaction effects between gender and emotional well-being and subjective health (Table 2). All the other interaction terms were statistically insignificant ($p>.05$). The interaction effects of rambling in nature between gender and and emotional well-being and subjective health are shown in Figure 1: participation in rambling in nature was associated with better emotional well-being and subjective health only among men. In both genders, positive associations were found between walking and psychological well-being, rambling in nature and social well-being, and endurance training and subjective health.

(Table 2)

(Fig 1)

3.3 Longitudinal Associations between LTPA and Mental Well-Being and Subjective Health

The first models testing measurement invariance in mental well-being and subjective health between ages 42 and 50 revealed that some of the error terms of the corresponding indicators of the latent variables had to be allowed to correlate to obtain an acceptable model fit. These error terms were emotional and social well-being between both ages in the mental well-being models, and self-rated health at both ages in the subjective health models. The model fit indices for the first mental well-being model were x^2=81.714 (df 16), p<.001; CFI=.846; RMSEA=.194 and for the model with correlated error terms x^2=6.724 (df 3), p=.081; CFI=.992; RMSEA=.061. The model fit indices for the corresponding subjective health models were x^2=48.878 (df 7), p<.001; CFI=.916; RMSEA=.135 and x^2=5.557 (df 4), p=.235; CFI=.997; RMSEA=.035.

In the mental well-being SEM models, constraining the factor loadings (difference test x2=0.94 (df=2), p=.624) and error variances (difference test x^2=3.02 (df=3), p=.389) to be equal between ages 42 and 50 did not lead to a significant reduction in model fit. In addition, multigroup testing showed that the same measurement model was suitable for both genders (difference test x^2=12.10 (df=6), p=.060). In the subjective health SEM models, the factor loadings (difference test x^2=.004 (df=1), p=.950), error variances (difference test x^2=5.783 (df=2), p=.056) and intercepts (difference test x^2=4.72 (df=2), p=.095) were constrained to be equal between time points. The multigroup analysis indicated no gender differences in the measurement model (difference test x^2=8.20 (df=4), p=.085).

The longitudinal models are presented in figures 2 and 3**.** Both models showed adequate fit: for mental well-being x^2=28.949 (df 19), p=.067; CFI=.984; RMSEA=.042, and for subjective health x^2=11.190 (df 9), p=.263; CFI=.993; RMSEA=.028. Mental well-being and subjective health showed high stability over time (β=.85, p<.001 for mental well-being and β=.77, p<.001 for subjective health). Mental well-being (including the absence of depressive symptoms) has previously shown high stability (Kokko et al. 2015).

In addition, LTPA was significantly stable (β=.42, p<.001). Mental well-being at age 42 preceded LTPA at age 50, whereas subjective health and LTPA showed no longitudinal associations. The multi-group analysis indicated equal paths between men and women (for mental well-being difference test x^2=12.104 (df=6), p=.060; and for subjective health difference test x^2=5.663 (df=6), p=.460). Therefore, the results are presented for the whole sample (Figures 2 and 3).

(Fig. 2 and 3)

4 Discussion

This study investigated the cross-sectional and longitudinal associations between LTPA, mental well-being and subjective health in middle-aged adults. As expected (H1), the cross-sectional analyses revealed that different types of LTPA were positively associated with subjective health and different dimensions of mental well-being. Interestingly, the direction of the longitudinal cross-lagged associations was not, as hypothesized (H2), from LTPA to mental well-being or subjective health. Instead, mental well-being at age 42 predicted LTPA at age 50. Moreover, LTPA and subjective health showed no longitudinal associations. The results also found an unexpected difference between men and women: participation in rambling was related to better emotional well-being and subjective health only among men. Thus, hypothesis 3 (H3) was partly supported.

While a positive association between LTPA and mental well-being has been widely reported (Brown et al. 2000; Holstila et al. 2017; Lahti et al. 2016; Penedo & Dahn 2005; Södergren et al. 2008; Wiese et al. 2018), the associations between different types of LTPA and different dimensions of mental well-being, and possible gender differences in these, have not previously been investigated in the same study. As previously mentioned, rambling in nature contributed to emotional well-being and subjective health only

among men. Rambling in nature may mean different things to men and women: men may prefer more intensive outdoor activities. For example, rambling in nature correlated positively with the frequency of exercise duration of at least half an hour, being out of breath and sweating among men, but not among women. This is in line with previous finding that greater stress release was observed among the park and forest visitors who practiced sports compared to less strenuous activities such as going for a walk (Hansmann, Hug, & Seeland 2007).

The other associations with well-being observed in this study were similar for both genders: walking was related to better psychological well-being and rambling in nature to better social well-being. These results may reflect the importance of outdoor activities and nature for well-being, as it has been shown earlier that connectedness with nature is positively associated with emotional, psychological and social well-being (Howell, Dopko, Passmore, & Buro 2011). Moreover, endurance training was the only type of LTPA associated with subjective health in both genders. It is possible that in midlife, when most people are relatively healthy, only more intensive types of LTPA, such as running, are related to better health. These results support previous findings that light or moderate intensity LTPA is related to mental well-being (Holstila et al. 2017; Panza et al. 2017) whereas more intensive LTPA is related to better subjective health (Galan et al. 2010). In contrast to some earlier findings (Andersen et al. 2018; Doré et al. 2016; Eime et al. 2010; O'Connor et al. 2010), this study did not find any associations between team and group sports or gym training and mental well-being/subjective health. These were the least commonly reported activities among the types of LTPA studied: less than one-third of the participants engaged in them at least once a month. It seems that these types of LTPA have more importance for younger or older adults than the middle-aged ones. In sum, to enhance all dimensions of well-being in midlife, diversity in LTPA is important: benefits are gained from both more intensive and more relaxing activities.

However, the longitudinal results of this study run counter to the expectation that LTPA leads to better mental well-being and subjective health (Newman et al. 2014; Sonnentag 2003; Sonnentag & Bayer 2005). The unexpected direction of the association also conflicts with earlier longitudinal research findings on LTPA and mental well-being and subjective health (deRezende et al. 2014; Holstila et al. 2017; Lahti et al. 2016; Takeda, Noguchi, Monma, & Tamiya 2015). The age of the participants, namely 42 to 50, may be the main reason for these unexpected results. This interpretation is supported by previous findings of a longitudinal association between LTPA and well-being among older (65+) men and women (Ku, Fox, Chang, Sun, & Chen 2014; Lee, C. & Russell 2003) but only a cross-sectional association among middle-aged women (Xu et al. 2010). Some evidence exists that LTPA is related to lower perceived stress levels among retired older adults but not among middle-aged employed adults (Zuzanek, Robinson, & Iwasaki 1998). Middle adulthood is typically the busiest time in people's lives, as it includes meeting responsibilities towards one's children and one's parents as well as high job demands, and thus leaves little free time for leisure activities (Knecht, Wiese, & Freund 2016; Lachman et al. 2015). It is possible that the present middle-aged participants also had only a small amount of leisure time and therefore other factors in their life were more important for their well-being. In addition, the eight-year interval between measurements leaves a lot of time for the possible occurrence of major life changes.

One potential mechanism behind the longitudinal association between mental well-being and LTPA is personality, which is closely related not only to mental well-being (Kokko et al. 2013; Steel, Schmidt, & Shultz 2008) but also to LTPA (Rhodes & Smith 2006). For example, the personality traits of playfulness (Proyer, Gander, Bertenshaw, & Brauer 2018) and activity (facet of extraversion) (Rhodes, Courneya, & Jones 2002; Røysamb, Nes, Czajkowski, & Vassend 2018) are linked to both mental well-being and LTPA. Like mental well-being (Kokko et al. 2013), personality has high rank-order stability in adulthood (Rantanen, Metsapelto, Feldt, Pulkkinen, & Kokko 2007; Roberts & DelVecchio 2000); this might explain why LTPA did not predict mental well-being in this study but vice versa. In future studies, it

would be interesting to study the potential mechanisms behind both the cross-sectional and longitudinal associations of LTPA with well-being.

In any case, it is clear that participation in LTPA in midlife has many benefits for both current and later health and functional capacity (Patel et al. 2006; Rovio et al. 2005), and hence it is important to find ways to promote participation in LTPA in midlife. Longitudinal investigation of the profiles of mental well-being conducted within the JYLS has shown that, in general, people with at least relatively good mental well-being function well in other areas of life such as work and social relations (Kokko & Feldt 2018). In addition, Rebar and Taylor (2017) have suggested that special attention should be paid to people with mental health issues, as the facilitators and barriers to participation in LTPA perceived by these individuals might diverge from those of the average population. It is possible that in midlife well-being is an important resource for promoting participation in LTPA, and therefore, individuals with low well-being should be especially targeted in campaigns to improved participation in LTPA.

4.1 Limitations

This study has its limitations. First, as this was a secondary analysis of a larger dataset, some of the measurements used were not optimal. The Cronbach´s alphas for overall life satisfaction (including satisfaction in seven life domains) were lower than 0.70, indicating somewhat low internal consistency. However, as overall life satisfaction was used together with three other measurements (happiness, positive mood and negative mood) to evaluate emotional well-being, the low alpha value should not have influenced the results. Additionally, the LTPA measurements were not optimal. LTPA at age 42 was measured with a single question; hence, especially in the longitudinal analysis, it was not possible to capture the phenomenon in its entirety. In addition to frequency of participation in LTPA, this study would have benefited from information about exercise intensity and duration. Second, having only two measurement points with comparable measures of physical activity frequency, it was not possible to use

more sophisticated statistical methods, such as growth curve modelling, to analyze change. Moreover, more measurement points at shorter intervals would have produced stronger evidence on the causal relationships between the study variables.

4.2 Conclusions

This study investigated the middle stages of midlife with a representative sample of the Finnish age cohort born in 1959. The cross-sectional results showed that different types of LTPA were associated with different dimensions of well-being and the longitudinal results that mental well-being predicted LTPA. To gain a more complete picture of the associations of age and life-stage differences with LTPA and subjective experiences of mental well-being and health, further studies that take the multidimensionality of both well-being and LTPA into account are called for. It is also important to find ways to promote mental well-being in midlife as this seems to be an important resource for participation in physical activity. In addition, middle-aged adults should be encouraged to find the time to participate in different types of physical activities, even if their leisure time is limited.

References

Andersen, M. H., Ottesen, L., & Thing, L. F. (2018). The social and psychological health outcomes of team sport participation in adults: An integrative review of research. *Scandinavian Journal of Public Health,* doi:10.1177/1403494818791405

Aro, H., Paronen, O., & Aro, S. (1987). Psychosomatic symptoms among 14–16 year old Finnish adolescents. *Social Psychiatry, 22*, 171-176.

Asztalos, M., Wijndaele, K., De Bourdeaudhuij, I., Philippaerts, R., Matton, L., Duvigneaud, N., . . . Cardon, G. (2012). Sport participation and stress among women and men. *Psychology of Sport and Exercise, 13*(4), 466-483.

Asztalos, M., De Bourdeaudhuij, I., & Cardon, G. (2010). The relationship between physical activity and mental health varies across activity intensity levels and dimensions of mental health among women and men. *Public Health Nutrition, 13*(8), 1207-1214.

Bennie, J. A., Pedisic, Z., Suni, J. H., Tokola, K., Husu, P., Biddle, S. J., & Vasankari, T. (2017). Self-reported health-enhancing physical activity recommendation adherence among 64,380 Finnish adults. *Scandinavian Journal of Medicine & Science in Sports, 27*(12), 1842-1853.

Blomstrand, A., Björkelund, C., Ariai, N., Lissner, L., & Bengtsson, C. (2009). Effects of leisure-time physical activity on well-being among women: a 32-year perspective. *Scandinavian Journal of Public Health, 37*(7), 706-712.

Brown, W. J., Mishra, G., Lee, C., & Bauman, A. (2000). Leisure time physical activity in Australian women: relationship with well being and symptoms. *Research Quarterly for Exercise and Sport, 71*(3), 206-216.

Chang, P., Lin, Y., & Song, R. (2018). Leisure satisfaction mediates the relationships between leisure settings, subjective well-being, and depression among middle-aged adults in urban China. *Applied Research in Quality of Life,* doi:10.1007/s11482-018-9630-3

de Bloom, J., Rantanen, J., Tement, S., & Kinnunen, U. (2018). Longitudinal leisure activity profiles and their associations with recovery experiences and job performance. *Leisure Sciences, 40*(3), 151-173.

deRezende, L. F. M., Rodrigues Lopes, M., Rey-López, J. P., Matsudo, V. K. R., & Luiz, O. C. (2014). Sedentary behavior and health outcomes: an overview of systematic reviews. *PloS One, 9*(8), e105620.

Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). Subjective well-being: three decades of progress. *Psychological Bulletin, 125*(2), 276-302.

Doré, I., O'Loughlin, J. L., Beauchamp, G., Martineau, M., & Fournier, L. (2016). Volume and social context of physical activity in association with mental health, anxiety and depression among youth. *Preventive Medicine, 91*, 344-350.

Eime, R. M., Harvey, J. T., Brown, W. J., & Payne, W. R. (2010). Does sports club participation contribute to health-related quality of life? *Medicine and Science in Sports and Exercise, 42*(5), 1022-1028.

Feldman, L. A. (1995). Valence arousal and arousal focus: individual differences in the structure of affective experience. *Journal of Personality and Social Psychology, 69*(1), 153-166.

Galan, I., Meseguer, C. M., Herruzo, R., & Rodriguez-Artalejo, F. (2010). Self-rated health according to amount, intensity and duration of leisure time physical activity. *Preventive Medicine, 51*(5), 378-383.

Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., Lee, I. M., . . . American College of Sports Medicine. (2011). American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Medicine and Science in Sports and Exercise, 43*(7), 1334-1359.

Hamer, M., Stamatakis, E., & Mishra, G. D. (2010). Television- and screen-based activity and mental well-being in adults. *American Journal of Preventive Medicine, 38*(4), 375-380.

Hansmann, R., Hug, S., & Seeland, K. (2007). Restoration and stress relief through physical activities in forests and parks. *Urban Forestry & Urban Greening, 6*(4), 213-225.

Hinrichs, T., Bonsdorff, M. B., Törmäkangas, T., Bonsdorff, M. E., Kulmala, J., Seitsamo, J., . . . Rantanen, T. (2014). Inverse effects of midlife occupational and leisure time physical activity on mobility limitation in old age—a 28-year prospective follow-up study. *Journal of the American Geriatrics Society, 62*(5), 812-820.

Holme, I., Tonstad, S., Sogaard, A. J., Larsen, P. G. L., & Haheim, L. L. (2007). Leisure time physical activity in middle age predicts the metabolic syndrome in old age: results of a 28-year follow-up of men in the Oslo study. *BMC Public Health, 7*(1), 154.

Holstila, A., Mänty, M., Rahkonen, O., Lahelma, E., & Lahti, J. (2017). Changes in leisure-time physical activity and physical and mental health functioning: a follow-up study. *Scandinavian Journal of Medicine & Science in Sports, 1785-1792*

Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural equation modelling: guidelines for determining model fit. *Electronic Journal on Business Research Methods, 6*(1), 53-60.

Howell, A. J., Dopko, R. L., Passmore, H., & Buro, K. (2011). Nature connectedness: associations with well-being and mindfulness. *Personality and Individual Differences, 51*(2), 166-171.

Keyes, C. L. (2005). Mental illness and/or mental health? Investigating axioms of the complete state model of health. *Journal of Consulting and Clinical Psychology, 73*(3), 539-548.

Keyes, C. L. (1998). Social well-being. *Social Psychology Quarterly, 61*, 121-140.

Kinnunen, M., Feldt, T., Kinnunen, U., & Pulkkinen, L. (2008). Self-esteem: An antecedent or a consequence of social support and psychosomatic symptoms? Cross-lagged associations in adulthood. *Journal of Research in Personality, 42*(2), 333-347.

Kinnunen, M., Kokkonen, M., Kaprio, J., & Pulkkinen, L. (2005). The associations of emotion regulation and dysregulation with the metabolic syndrome factor. *Journal of Psychosomatic Research, 58*(6), 513-521.

Knecht, M., Wiese, B. S., & Freund, A. M. (2016). Going beyond work and family: A longitudinal study on the role of leisure in the work-life interplay. *Journal of Organizational Behavior, 37*(7), 1061-1077.

Kokko, K., & Feldt, T. (2018). Longitudinal profiles of mental well-being as correlates of successful aging in middle age. *International Journal of Behavioral Development, 42*(5), 485-495.

Kokko, K., Rantanen, J., & Pulkkinen, L. (2015). Associations between mental well-being and personality from a life span perspective. In M. Blatný (Ed.), *Personality and well-being across the life-span* (pp. 134-159). London: Palgrave.

Kokko, K., Korkalainen, A., Lyyra, A., & Feldt, T. (2013). Structure and continuity of well-being in mid-adulthood: a longitudinal study. *Journal of Happiness Studies, 14*(1), 99-114.

Kokko, K., Tolvanen, A., & Pulkkinen, L. (2013). Associations between personality traits and psychological well-being across time in middle adulthood. *Journal of Research in Personality, 47*(6), 748-756.

Kokko, K. (2010). Psyykkinen hyvinvointi. In L. Pulkkinen, & K. Kokko (Eds.), *Keski-ikä elämänvaiheena [Middle age as a stage of life]* (pp. 91-96). University of Jyväskylä: Department of Psychology.

Kokkonen, M. (2001). *Emotion regulation and physical health in adulthood: a longitudinal, personality-oriented approach. Jyväskylä Studies in Education, Psychology and Social Research, No. 184.* Jyväskylä, Finland: University of Jyväskylä.

Ku, P., Fox, K., Chang, C., Sun, W., & Chen, L. (2014). Cross-sectional and longitudinal associations of categories of physical activities with dimensions of subjective well-being in Taiwanese older adults. *Social Indicators Research, 117*(3), 705-718.

Lachman, M. E., Teshale, S., & Agrigoroaei, S. (2015). Midlife as a pivotal period in the life course: balancing growth and decline at the crossroads of youth and old age. *International Journal of Behavioral Development, 39*(1), 20-31.

Lachman, M. E. (2004). Development in midlife. *Annual Review of Psychology, 55*, 305-331.

Lahti, J., Sabia, S., Singh-Manoux, A., Kivimaki, M., Tatsuse, T., Yamada, M., . . . Lallukka, T. (2016). Leisure time physical activity and subsequent physical and mental health functioning among midlife Finnish, British and Japanese employees: a follow-up study in three occupational cohorts. *BMJ Open, 6*(1), 009788.

Lee, B., Lawson, K. M., Chang, P., Neuendorf, C., Dmitrieva, N. O., & Almeida, D. M. (2015). Leisure-time physical activity moderates the longitudinal associations between work-family spillover and physical health. *Journal of Leisure Research, 47*(4), 444-466.

Lee, C., & Russell, A. (2003). Effects of physical activity on emotional well-being among older Australian women: cross-sectional and longitudinal analyses. *Journal of Psychosomatic Research, 54*(2), 155-160.

Mayer, J. D., & Gaschke, Y. N. (1988). The experience and meta-experience of mood. *Journal of Personality and Social Psychology, 55*(1), 102-111.

McAuley, E., & Rudolp, D. (1995). Physical activity, aging and psychological well-being. *Journal of Aging and Physical Activity, 3*, 67-96.

Metsäpelto, R., Polet, J., Kokko, K., Rantanen, J., Kinnunen, M., Pitkänen, T., . . . Pulkkinen, L. (2010). Tutkimuksen toteutus. In Pulkkinen, L. & Kokko, K. (Ed.), *Keski-ikä elämänvaiheena. Jyväskylän yliopiston psykologian laitoksen julkaisuja 352* (pp. 5-19). Jyväskylä: University of Jyväskylä.

Mikkelsen, K., Stojanovska, L., Polenakovic, M., Bosevski, M., & Apostolopoulos, V. (2017). Exercise and mental health. *Maturitas, 106*, 48-56.

Muthén, L. K., & Muthén, B. O. (2017). *Mplus User's Guide* (8th ed.). Los Angeles, CA: Muthén & Muthén.

Nawijn, J., & Veenhoven, R. (2013). Happiness through leisure. In T. Freire (Ed.), *Positive Leisure Science: From Subjective Experience to Social Contexts* (pp. 193-209). Dordrecht: Springer Netherlands.

Netz, Y., Wu, M. J., Becker, B. J., & Tenenbaum, G. (2005). Physical activity and psychological well-being in advanced age: a meta-analysis of intervention studies. *Psychology and Aging, 20*(2), 272-284.

Newman, D. B., Tay, L., & Diener, E. (2014). Leisure and subjective well-being: a model of psychological mechanisms as mediating factors. *Journal of Happiness Studies, 15*(3), 555-578.

O'Connor, P. J., Herring, M. P., & Caravalho, A. (2010). Mental health benefits of strength training in adults. *American Journal of Lifestyle Medicine, 4*(5), 377-396.

Oh, S. H., Son, S. H., Kang, S. H., Kim, D. K., Seo, K. M., & Lee, S. Y. (2017). Relationship between types of exercise and quality of life in a Korean metabolic syndrome population: a cross-sectional study. *Metabolic Syndrome and Related Disorders, 15*(4), 199-205.

Panza, G. A., Taylor, B. A., Thompson, P. D., White, C. M., & Pescatello, L. S. (2017). Physical activity intensity and subjective well-being in healthy adults. *Journal of Health Psychology,* doi:10.1177/1359105317691589

Patel, K. V., Coppin, A. K., Manini, T. M., Lauretani, F., Bandinelli, S., Ferrucci, L., & Guralnik, J. M. (2006). Midlife physical activity and mobility in older age: The InCHIANTI study. *American Journal of Preventive Medicine, 31*(3), 217-224.

Penedo, F. J., & Dahn, J. R. (2005). Exercise and well-being: a review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry, 18*(2), 189-193.

Perho, H., & Korhonen, M. (1993). Elämänvaiheiden onnellisuus ja sisältö keski-iän kynnyksellä [Happiness and content of different life phases in the frontier of midadulthood]. *Gerontologia, 7*, 271-285.

Pietilä, M., Neuvonen, M., Borodulin, K., Korpela, K., Sievänen, T., & Tyrväinen, L. (2015). Relationships between exposure to urban green spaces, physical activity and self-rated health. *Journal of Outdoor Recreation and Tourism, 10*, 44-54.

Proyer, R. T., Gander, F., Bertenshaw, E. J., & Brauer, K. (2018). The positive relationships of playfulness with indicators of health, activity, and physical fitness. *Frontiers in Psychology, 9*, 1440.

Pulkkinen, L. (2017). *Human development from middle childhood to middle adulthood: growing up to the middle-aged (In collaboration with Katja Kokko)*. London: Routledge.

Pulkkinen, L. (2006). The Jyväskylä Longitudinal Study of Personality and Social Development. In L. Pulkkinen, J. Kaprio & R. J. Rose (Eds.), *Socioemotional development and health from adolescence to adulthood.* (pp. 29-55) New York: Cambridge University Pres.

Rantanen, J., Metsapelto, R. L., Feldt, T., Pulkkinen, L., & Kokko, K. (2007). Long-term stability in the Big Five personality traits in adulthood. *Scandinavian Journal of Psychology, 48*(6), 511-518.

Rebar, A. L., & Taylor, A. (2017). Physical activity and mental health; it is more than just a prescription. *Mental Health and Physical Activity, 13*, 77-82.

Rhodes, R. E., & Smith, N. E. I. (2006). Personality correlates of physical activity: a review and meta-analysis. *British Journal of Sports Medicine, 40*(12), 958-965.

Rhodes, R. E., Courneya, K. S., & Jones, L. W. (2002). Personality, the Theory of Planned Behavior, and Exercise: A Unique Role for Extroversion's Activity Facet. *Journal of Applied Social Psychology, 32*(8), 1721-1736.

Roberts, B. W., & DelVecchio, W. F. (2000). The rank-order consistency of personality traits from childhood to old age: a quantitative review of longitudinal studies. *Psychological Bulletin, 126*(1), 3-25.

Rovio, S., Kareholt, I., Helkala, E. L., Viitanen, M., Winblad, B., Tuomilehto, J., . . . Kivipelto, M. (2005). Leisure-time physical activity at midlife and the risk of dementia and Alzheimer's disease. *The Lancet Neurology, 4*(11), 705-711.

Røysamb, E., Nes, R. B., Czajkowski, N. O., & Vassend, O. (2018). Genetics, personality and wellbeing. A twin study of traits, facets and life satisfaction. *Scientific Reports, 8*, 12298.

Ryan, R. M., & Deci, E. L. (2001). On happiness and human potentials: a review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology, 52*, 141-166.

Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology, 57*, 1069-1081.

Sargent-Cox, K., Cherbuin, N., Morris, L., Butterworth, P., & Anstey, K. J. (2014). The effect of health behavior change on self-rated health across the adult life course: A longitudinal cohort study. *Preventive Medicine, 58*, 75-80.

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research Online, 8*(2), 23-74.

Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A., & King, J. (2006). Reporting structural equation modeling and confirmatory factor analysis results: a review. *The Journal of Educational Research, 99*(6), 323-338.

Seligman, M. E. P. (2008). Positive health. *Applied Psychology, 57*(s1), 3-18.
Södergren, M., Sundquist, J., Johansson, S., & Sundquist, K. (2008). Physical activity, exercise and self-rated health: a population-based study from Sweden. *BMC Public Health, 8*, 352.
Sonnentag, S., & Bayer, U. (2005). Switching off mentally. *Journal of Occupational Health Psychology, 10*(4), 393-414.
Sonnentag, S. (2003). Recovery, work engagement, and proactive behavior : a new look at the interface between nonwork and work. *The Journal of Applied Psychology, 88*(3), 518-528.
Steel, P., Schmidt, J., & Shultz, J. (2008). Refining the relationship between personality and subjective well-being. *Psychological Bulletin, 134*(1), 138-161.
Steinmo, S., Hagger-Johnson, G., & Shahab, L. (2014). Bidirectional association between mental health and physical activity in older adults: Whitehall II prospective cohort study. *Preventive Medicine, 66*, 74-79.
Takeda, F., Noguchi, H., Monma, T., & Tamiya, N. (2015). How possibly do leisure and social activities impact mental health of middle-aged adults in Japan?: An evidence from a national longitudinal survey. *PloS One, 10*(10), e0139777.
Weiss, D. R., O'Loughlin, J. L., Platt, R. W., & Paradis, G. (2007). Five-year predictors of physical activity decline among adults in low-income communities: a prospective study. *The International Journal of Behavioral Nutrition and Physical Activity, 4*(1), 2.
Wiese, C. W., Kuykendall, L., & Tay, L. (2018). Get active? A meta-analysis of leisure-time physical activity and subjective well-being. *The Journal of Positive Psychology, 13*(1), 57.
Williams, T., Guerin, E., & Fortier, M. (2014). Conflict between women's physically active and passive leisure pursuits: The role of self-determination and influences on well-being. *Applied Psychology: Health and Well-Being, 6*(2), 151-172.
Wolf, I. D., & Wohlfart, T. (2014). Walking, hiking and running in parks: a multidisciplinary assessment of health and well-being benefits. *Landscape and Urban Planning, 130*, 89-103.
Xu, Q., Anderson, D., & Courtney, M. (2010). A longitudinal study of the relationship between lifestyle and mental health among midlife and older women in Australia: findings from the Healthy Aging of Women study. *Health Care for Women International, 31*(12), 1082-1096.
Zuzanek, J., Robinson, J. P., & Iwasaki, Y. (1998). The relationships between stress, health, and physically active leisure as a function of life-cycle. *Leisure Sciences, 20*(4), 253-275.

Table 1. Descriptive statistics and bi-variate correlations between the study variables.

				Age 42	Age 50					
Variables	M	SD	ES	LTPA	LTPA	Walking	ET	GTS	GT	RIN
Age 42										
Life satisfaction	3.08	.43		.02	.10	.14*	-.02	-.08	.08	.15*
Positive mood	2.82	.67		-.02	.05	.11	-.05	-.04	.06	.14
Negative mood[a]	3.81	.30		-.07	.18**	.11	-.04	.03	.03	.09
Happiness	1.64	1.32		.10	.13	.08	-.05	-.09	-.05	.03
Psychological well-being	3.14	.34		.08	.16*	.12	-.02	.04	.08	.08
Social well-being	2.82	.38		-.00	.14*	.15*	-.01	-.02	.05	.14*
Self-rated health	2.81	.77		.05	.08	.08	.14*	.09	.06	-.02
Psychosomatic symptoms[a]	2.45	.33		-03	-.10	.01	.09	.02	.08	-.03
LTPA	3.86	1.51			.41***	.16*	.22**	.11	.21**	.15*
Age 50										
Life satisfaction	3.08	.44	-.02	.03	.06	.07	.07	.06	.07	.14*
Positive mood	2.91	.61	.12	-.02	.13*	.08	.10	.11	.12	.08
Negative mood[a]	3.81	.32	.00	-.07	.07	.01	.04	.03	.06	.05
Happiness	1.89	.99	.22[b]	.04	.11	.21**	.12	.05	.10	.17*
Psychological well-being	3.18	.33	.14	.01	.14*	.19**	.03	-.03	-.01	.12
Social well-being	2.96	.39	.43[b]	.11	.03	.16*	.01	-.02	.02	.24***
Self-rated health	2.78	.84	-.09	.06	.21**	.15*	.20**	.11	.15*	.06
Psychosomatic symptoms[a]	2.41	.34	-.12	-.04	-.18**	-.06	-.21**	-.12	-.15*	.05
LTPA	4.20[a]	1.55	.25[b]	.41***		.28***	.20**	.20**	.26***	.01
Walking	2.89	.90								
Endurance training	2.02	.60								
Group & team sports	1.53	.68								
Gym training[c]										
<1x/month	69.6%									
≥1x/month	30.4%									
Rambling in nature[b]										
<1x/month	56.3%									
≥1x/month	43.7%									

ES=effect size, LTPA=Leisure time physical activity, ET=endurance training, GTS=group and team sports, GT=gym training, RIN=rambling in nature. [a]Reversed scale, [b]paired sample t-test p<.05 between times, [c]Frequencies presented, correlations *p<.05, **p<.01, ***p<.001

Table 2. Linear regression analysis of types of leisure time physical activity on the dimensions of well-being at age 50

	Emotional well-being		Psychological well-being		Social well-being		Subjective health	
	β	p	β	p	β	p	β	p
Walking	.14	.202	.35	.001	.10	.336	.08	.437
Endurance training	.18	.129	.01	.908	-.04	.704	.32	.007
Group&team sports	.18	.141	-.11	.360	-.02	.847	.06	.594
Gym training	.01	.896	-.07	.493	-.07	.477	.07	.515
Rambling in nature	-.15	.153	.14	.183	.24	.025	-.17	.118
Gender	-1.21	.006	-.29	.494	.32	.451	-.51	.240
Gender * walking	-.20	.560	-.57	.088	.25	.455	.13	.697
Gender * endurance training	-.46	.153	-.07	.830	-.10	.757	-.52	.109
Gender * group&team sports	-.44	.100	.16	.546	.09	.745	-.08	.754
Gender*gym training	.07	.560	.09	.426	.09	.433	-.04	.710
Gender * rambling in nature	.35	.005	-.17	.162	-.08	.516	.25	.042
Model p	.002		<.001		.001		.002	
Model Adj. R^2	.09		.14		.11		.10	

Models adjusted by educational level and marital status.

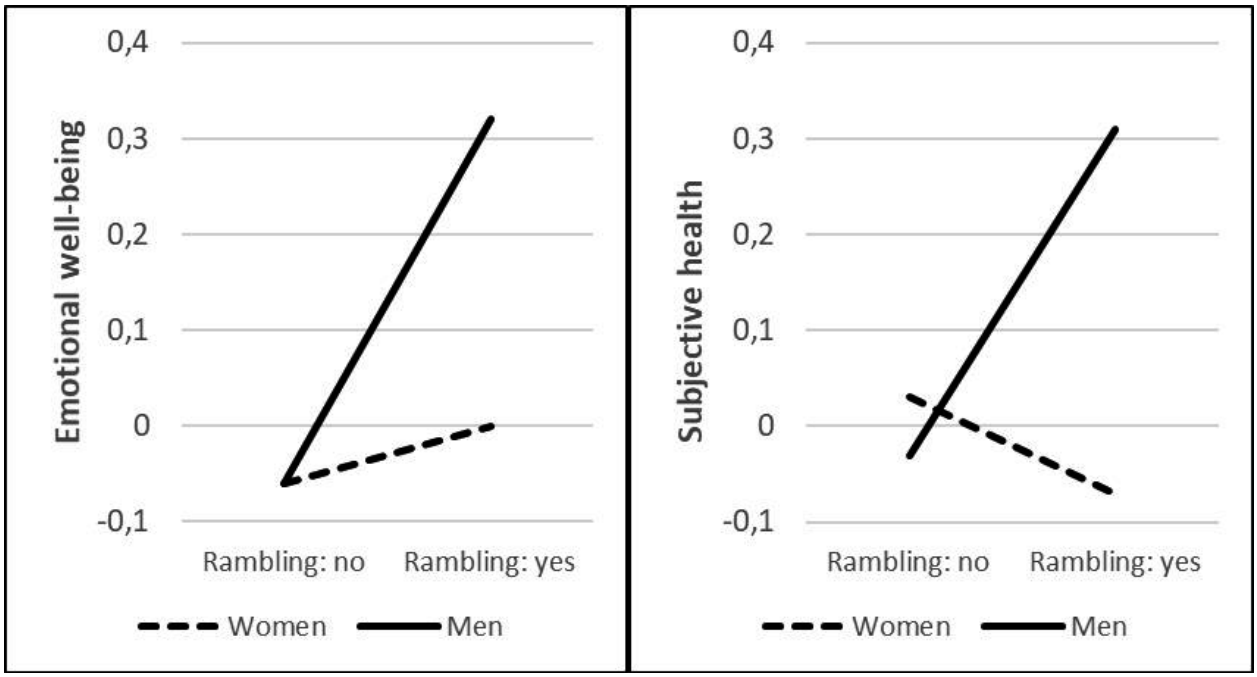

Fig 1. Interaction effect of participation in rambling in nature and gender on emotional well-being and subjective health.

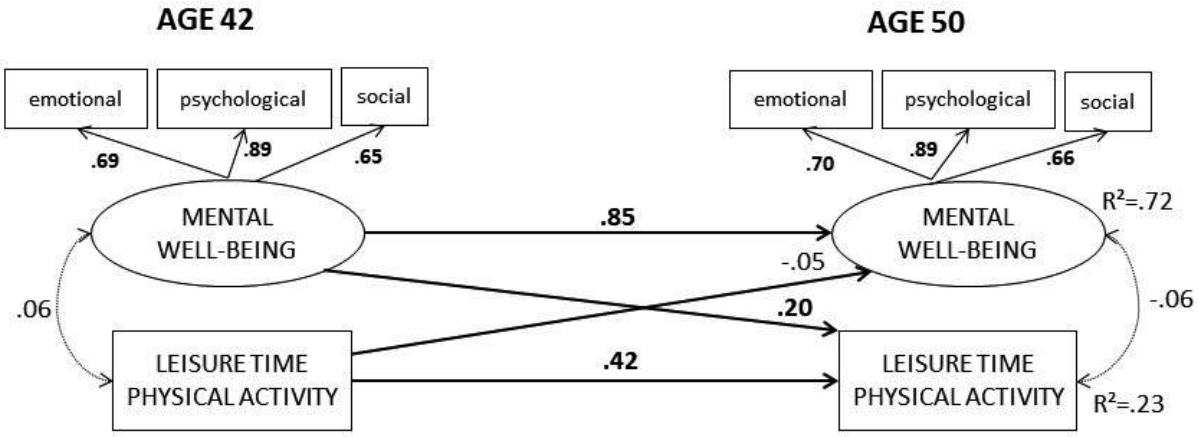

Fig 2. Longitudinal associations between leisure time physical activity and mental well-being. Structural equation model with standardized regression coefficients. Statistically significant (p<.05) coefficients bolded. For ease of reading. error terms are not shown. Model fit: x^2=28.949 (df 19). p=.067; CFI=.984; RMSEA [90% CI] =0.042 [0.000. 0.071]. SRMR=0.044.

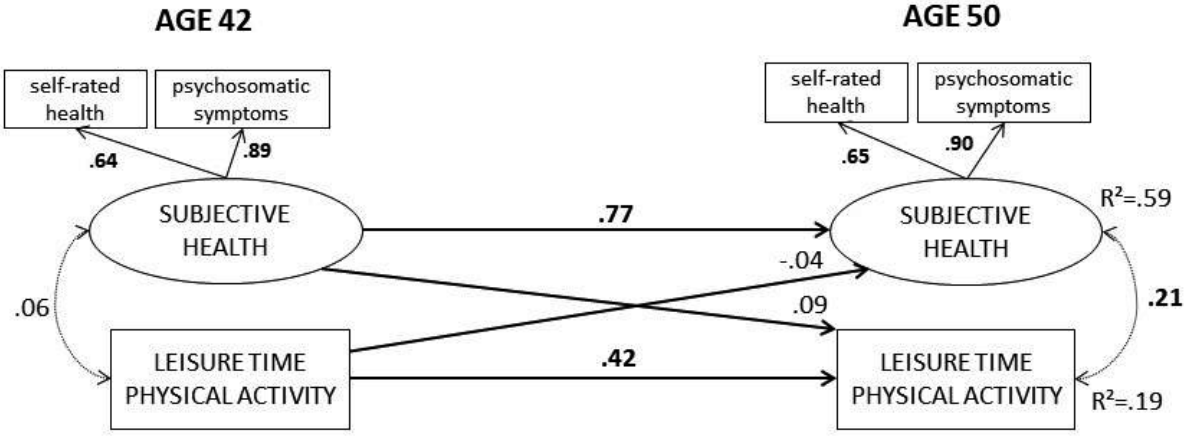

Fig 3. Longitudinal associations between leisure time physical activity and subjective health. Structural equation model with standardized regression coefficients. Statistically significant (p<.05) coefficients bolded. For ease of reading. error terms are not shown. Model fit: x^2=11.190 (df 9). p=.263; CFI=.993; RMSEA [90% CI] =0.028 [0.000. 0.074]. SRMR=0.065.

III

EFFECTS OF A 9-MONTH RESISTANCE TRAINING INTERVENTION ON QUALITY OF LIFE, SENSE OF COHERENCE, AND DEPRESSIVE SYMPTOMS IN OLDER ADULTS: RANDOMIZED CONTROLLED TRIAL

by

Kekäläinen T, Kokko K, Sipilä S, Walker S. 2018

Quality of Life Research 27 (2): 455–465

Qual Life Res (2018) 27:455–465
DOI 10.1007/s11136-017-1733-z

Effects of a 9-month resistance training intervention on quality of life, sense of coherence, and depressive symptoms in older adults: randomized controlled trial

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Accepted: 1 November 2017 / Published online: 9 November 2017

Abstract
Purpose (1) To determine the effects of a 9-month resistance training intervention on quality of life, sense of coherence, and depressive symptoms in older adults, and (2) to compare effects between different training frequencies.
Methods Men and women aged 65–75 ($N = 106$) were randomized to four groups according to training frequency: training groups RT1 ($n = 26$), RT2 ($n = 27$), and RT3 ($n = 28$) and non-training control group ($n = 25$). All training groups attended supervised resistance training twice a week for 3 months. For the following 6 months, they continued training with different frequencies (1, 2 or 3 times per week). Psychological functioning was measured by quality of life (WHOQOL-Bref), sense of coherence (Antonovsky's SOC-13), and depressive symptoms (Beck's Depression Inventory II). Measurements were conducted at baseline and 3 and 9 months after baseline. The effects of the intervention were analyzed using generalized estimating equations (GEE).
Results After 3 months, there was an intervention effect on environmental quality of life (group × time $p = .048$). Between 3 and 9 months, environmental quality of life decreased among RT1 compared to RT2 and RT3 (group × time $p = .025$). Between baseline and 9 months, environmental quality of life increased in RT2 compared to all other groups (group × time $p = .011$). Sense of coherence increased in RT2 compared to the control group and RT3 (group × time $p = .032$).
Conclusion Resistance training is beneficial for environmental quality of life and sense of coherence. Attending resistance training twice a week seems to be the most advantageous for these aspects of psychological functioning.

Keywords Quality of life · Aging · Exercise · Well-being · Coping · Mood

Introduction

Quality of life (QoL) is a major area of interest in a wide range of fields. The World Health Organization [1] has defined QoL as "individuals' perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns." QoL is a subjective evaluation, which is related to an individual's cultural, social, and environmental context, and encompasses four different domains: physical, psychological, social, and environmental [1]. Of these domains, especially the physical domain tends to decrease with age [2].

Sense of coherence (SoC) and depressive symptoms (DS) are both closely related to QoL [3–5]. According to Antonovsky's salutogenesis theory [6], SoC is a life orientation and reflects an individual's perception of how meaningful, manageable, and comprehensible their life is. SoC could be seen as a health resource, because it reveals how people perceive life and use their resources to cope with stressors. Both cross-sectional and longitudinal studies [3] have shown SoC to be related to QoL. Unlike SoC, depression is a major mental health problem [7]. Even minor levels of depression are related to poorer QoL in

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all domains [4, 5] and to weaker SoC [8]. Hence, both SoC and DS are worth considering when promoting older adults' QoL.

Physical activity is a key factor to maintain health and functional capacity during aging. Both aerobic physical activity (e.g., at least 150 min/week in moderate intensity) and muscle-strengthening activities (at least twice a week) are recommended activities for older adults [9]. Only a minority of older adults meet these recommendations, especially for muscle-strengthening activities [10]. This is alarming, because resistance training (RT) offers major benefits, such as improving strength and power, increasing muscle mass, reducing risk of functional limitations, difficulties in daily tasks and falls, and enables individuals to stay physically active [11, 12]. In addition to physical benefits, earlier literature has shown that exercise is positively associated with psychological functioning, such as QoL and DS, in older adults [13–16]. The underlying reasons why exercise was shown to be beneficial to psychological functioning may have been related to improvements in physical functioning (e.g., muscle strength, cardiovascular functioning), social interaction, or mastery experiences gained during exercise [14, 17], for example.

The effect of RT on QoL is still unclear; in some intervention studies RT appeared to have a positive effect especially on the physical domain of QoL [18–20], whereas in others no effects were found [21–23]. Positive effects have been found both after shorter (e.g., 12 weeks) [18, 19] and longer (e.g., 8 months) [20] RT interventions. Only few studies have reported the effects of RT on SoC. Among older adults with hip fracture history, a 12-week strength training intervention (training twice a week) did not influence SoC [24], whereas another 10-month strength/flexibility/balance training intervention study (training three times a week) had a positive within-group effect on SoC [25]. Previous studies are more consistent regarding DS; evidence shows that RT slightly reduces DS in both healthy older adults and those with diagnosed depression [26, 27]. Therefore, it seems that RT may have a positive influence on psychological functioning, but more studies are needed to uncover the effects of RT on specific areas of psychological functioning among older adults.

Another unclear area is the effect of RT frequencies on psychological functioning. One earlier study compared the effect of RT two or three times a week [28] in older women and another study RT three or four times a week [29] on QoL in middle-aged women. In these two studies, both intervention groups improved their QoL without significant between-group differences. However, the durations of the interventions were 12 [28] and 8 [29] weeks, so it is not clear whether training frequencies have different effects after long-term RT. In addition, training frequency has usually been two or three times a week and it is unclear whether RT only once a week could have an effect on psychological functioning.

The purpose of this study was to (1) investigate the effects of RT intervention on psychological functioning, assessed here by QoL, SoC, and DS, in older adults after 3 and 9 months of training and (2) compare the effect of different training frequencies (one, two, or three times a week) on these areas of psychological functioning. The present study was based on a secondary analysis of a randomized controlled trial investigating the minimum training frequency to improve neuromuscular performance and health among older adults. Physical performance results from the same trial show that RT increased maximum strength [30] and cardiorespiratory fitness after 3 months of training [31], and a higher training frequency provided greater benefit for maximum dynamic strength but not for functional capacity over 9 months [32]. Based on those results and previous studies on psychological functioning, we hypothesized that RT is beneficial for psychological functioning already after 3-month training and there are no differences between frequencies.

Methods

Study design and participants

The present study was based on a secondary analysis of a parallel-group randomized controlled trial, "Minimum resistance training frequency: effect on motivation and adherence to train, overall health status and neuromuscular performance" (NCT02413112). The trial is described in further detail in previous studies [30–32]. The flowchart of the study is shown in Fig. 1. Pre-trial statistical power analysis was performed for the primary outcomes, maximum strength, and functional capacity, based on the effect sizes reported in a meta-analysis by Liu and Latham [33]. With a 75:25 intervention-to-control ratio, a sample size of 44 (intervention) and 15 (control) for strength and 66 and 22 for functional capacity was necessary to reach 80% probability that treatment differences could be observed with a 5% level of significance. Two thousand invitation letters were sent to a random sample of community-dwelling 65–75-year-old older adults living in the Jyväskylä area. In total, 454 (23%) responded by filling in an online registration form. The exclusion criteria were (1) regular aerobic exercise (over 3 h/week), (2) RT experience, (3) BMI > 37, (4) previous testosterone-altering treatment, (5) serious cardiovascular disease that may lead to complications during exercise, (6) use of pharmaceuticals that affect the neuromuscular or endocrine systems, (7) use of walking aids, and (8) smoking. Potential participants ($n = 148$ of 454) were invited to an information session. One hundred and sixteen persons provided written informed consent and attended a doctor's examination to

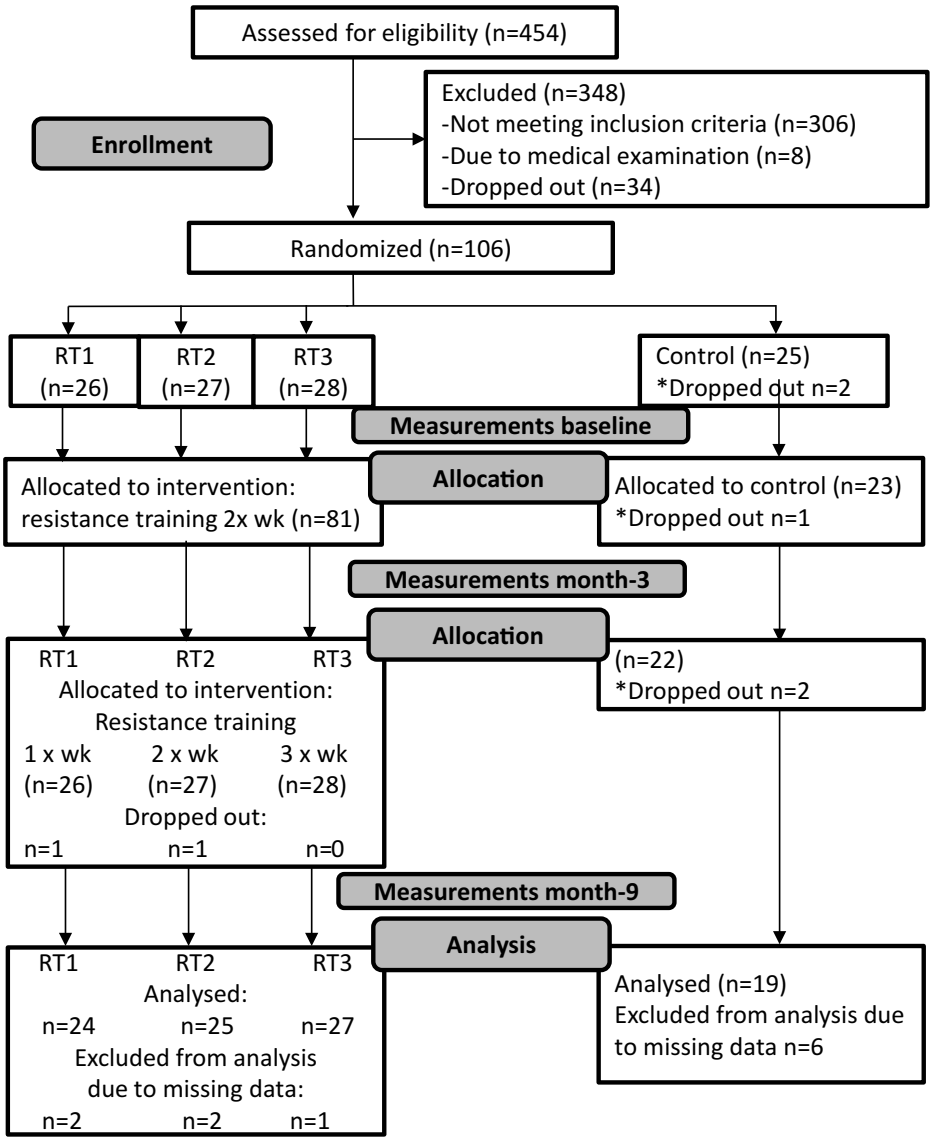

Fig. 1 Flow diagram of the study

assess their health and ability to perform RT; eight persons were excluded due to medical reasons. After two drop-outs, 106 participants were randomized by a random number generator (online) in a block of 100 subjects, so that 25 subjects were selected into each group. Each number in sequence was allocated to each group in descending order. The remaining six subjects were randomized within the training groups. As it was assumed that training three times a week likely increased the chance of drop-out and/or non-compliance, three subjects were randomized to group 3, two to group 2, and one to group 1. The study groups were RT once a week (RT1, $n=26$), twice a week (RT2, $n=27$), three times a week (RT3, $n=28$), and non-training control group (CG, $n=25$). After randomization, two participants from CG dropped out because they were dissatisfied with the results of randomization. Hence, 104 participants started the study. CG was instructed not to change their lifestyle during the intervention, and after post-intervention measurements, they had an opportunity to participate in supervised RT twice a week for 6 months. Ethical approval was obtained from the University of Jyväskylä Ethical Committee.

Intervention

All training sessions were performed at the gym in the University of Jyväskylä, and were supervised by experienced personnel. Each training session lasted for 1 h, and consisted of a 10-min warm-up and 8–9 exercises for different muscle groups. *Months 1–3*: All three training groups trained twice a week, to become familiar with RT methods, and to build capacity for subsequent high-load training. The focus was on local muscular endurance using low loads. *Months 4–9*:

The training groups split into different training frequencies in which they were randomized: For RT1, this represented a reduced and for RT3 an increased training frequency. All training groups followed identical two-session training programs: completing one cycle took 2 weeks for RT1, 1 week for RT2, and RT3 completed three cycles in 2 weeks. Training during months 4–9 was progressively periodized RT, focused on muscle hypertrophy and maximum strength.

Measurements

Quality of life

QoL was assessed using the WHOQOL-BREF questionnaire, which is a shortened version of the WHOQOL-100 [1]. The WHOQOL-BREF is a valid and reliable method to measure QoL in older adults [2, 34]. WHOQOL-BREF includes 26 questions and covers all four domains of QoL. The participants scored the items on a scale from 1 to 5, and the raw domain scores were transformed to a scale of 4–24. Cronbach's alphas for physical domain were .70, .68, and .70, for psychological domain .77, .76, and .77, for social domain .67, .78, and .77, and for environmental domain .65, .75, and .79 at baseline, 3, and 9 months, respectively.

Sense of coherence

SoC was measured by Antonovsky's 13-item scale, derived from the original 29-item scale [6, 35]. SoC scale is a widely used reliable and valid measurement [35]. The answers were given on a scale from 1 to 7, and aggregated. Cronbach's alphas were .77, .80, and .82 at baseline, 3, and 9 months, respectively.

Depressive symptoms

DS were assessed with the Beck Depression Inventory II (BDI-II), which is a revised version of the original BDI [36]. The BDI-II has adequate reliability and validity in all age groups [37]. The inventory consists of 21 statements, which are scored from not present (0) to severe (3), and the overall scoring range is 0–63. Cronbach's alphas were .72 at baseline, .77 at month-3, and .77 at month-9.

Aerobic exercise

The mean amount (minutes/week) of aerobic exercise at baseline was obtained by a self-reported questionnaire. Physical activity diaries tracked daily leisure-time aerobic exercise throughout the study. The average weekly aerobic exercise in months 1–3 and 4–9 was calculated.

Strength and functional capacity

The protocols to measure strength and functional capacity are described previously [30–32]. A bilateral leg press one-repetition maximum (1-RM) was used to assess maximum strength. Functional capacity was assessed by time to complete 7.5 m forward and backward walk, timed-up-and-go (TUG), and loaded 10-stair climb tests.

Statistics

Analyses were performed using IBM SPSS Statistics 24.0 (IBM Corp., released 2016, IBM SPSS Statistics for Windows, Armonk, NY). Results presented here were analyzed by intention-to-treat principle with the exception of those two participants who dropped out from CG before baseline measurements right after the randomization.

The effect of the intervention on QoL, SoC, and DS was analyzed by generalized estimating equation (GEE) models with an unstructured working correlation matrix. The advantage of the GEE method is that when pre- or post-intervention measurement is missing, it utilizes the information also from incomplete pair of observations [38]. Three sets of GEE models were performed. First, the differences between the training group and CG from baseline to month-3 were tested. Second, the differences between CG, RT1, RT2, and RT3 from month-3 to month-9 were tested, and third, the differences between these four groups from baseline to month-9 were tested.

The amount of leisure-time aerobic exercise (min/week) was not stable in all groups during the intervention. CG had significantly higher amount of aerobic exercise in months 1–3 (mean 193 min/week) and 4–9 (172 min/week) compared to baseline (110 min/week) (paired sample t-test $p = .028$ and $p = .039$, respectively), and RT3 in months 1–3 (145 min/week) compared to baseline (85 min/week) ($p = .007$). Therefore, GEE analyses were adjusted by average aerobic exercise (min/week). Leisure-time physical activity diaries from months 1–3 were missing from 19 participants, of which 11 were from CG. The missing data for CG participants were imputed using linear regression imputation, with baseline and 4–9 months of aerobic exercise as predictors, for those ($n = 7$) who had both values. After the imputation, the final sample sizes for GEE analyses were 19/23 in CG and 73/81 in the training group for baseline to month-3 analyses (9% missing) and 19/23 in CG, 24/26 in the RT1, 25/27 in the RT2, and 27/28 in the RT3 for month-3 to month-9 and baseline to month-9 analyses (9% missing).

Changes in outcome variables were calculated by subtracting the previous value from the intervention completion value. The standardized effect sizes for differences between groups were calculated with Cohen's *d* formula [39]. Within-group differences were analyzed by paired sample *t* tests.

Results

There were one drop-out from CG between baseline and month-3, and four drop-outs (two from CG, one from RT1, and one from RT2) between month-3 and month-9 (Fig. 1). There were no significant differences ($p > .05$) between the groups in participants' characteristics (Table 1) and QoL, SoC, and DS (Table 2) at baseline.

Results for QoL, SoC, and DS are presented in Tables 2 and 3. After the 3-month intervention, there were within-group improvements in physical and psychological QoL and SoC in the training group and in DS in both training group and CG. The only significant group × time difference was found in environmental QoL (Table 3; Fig. 2a). From month-3 to month-9, different frequencies were used by the training groups. Social QoL decreased in RT3 and SoC increased in RT2. The only significant change between the groups occurred in the environmental QoL (Table 3; Fig. 2b). Environmental QoL decreased in RT1 compared to RT2 and RT3. From baseline to month-9, psychological QoL and SoC improved in RT1 and RT2, social QoL decreased and environmental QoL increased in RT2, and DS decreased in RT2, RT3, and CG. SoC and the environmental QoL showed a significant group × time interaction (Table 3; Fig. 2c). Throughout the 9-month intervention, both SoC and environmental QoL increased in RT2 compared to CG and to RT3, and environmental QoL also compared to RT1. According to effect sizes (Table 2), the changes in SoC and environmental QoL in RT2 were large compared to CG (effect sizes > 0.80) and medium compared to RT1 and RT3 (effect sizes > 0.50). The correlations between changes in QoL, SoC, DS, strength, and functional capacity are shown in Table 4.

Discussion

The purpose of this study was to determine the effects of RT on QoL, SoC, and DS, as well as to compare the possible effects of different training frequencies on those variables. After a 3-month training period, there was an intervention effect on environmental dimension of QoL. From month-3 to month-9, environmental QoL decreased among those who trained once a week compared to higher training frequencies. Throughout the 9-month intervention, participants who trained twice a week improved their environmental QoL compared to all other groups and SoC compared to CG and to RT3. Therefore, our hypothesis regarding the positive effect of RT on psychological outcomes was partly supported.

We found an intervention effect on environmental QoL after 3 months of training. This is a novel finding, partly because the environmental dimension of QoL is not part of commonly used health-related QoL measurements (e.g., RAND-36/SF-36). Bonganha et al. [22] used the same WHOQOL-BREF questionnaire, and did not observe any changes in environmental QoL after a 16-week 3-times-a-week RT program, but their participants were younger (post-menopausal women) than in the present study. The environmental QoL reflects how satisfied individuals are with their environment and with their access to different services. In the present study, the change in environmental QoL during the first 3 months correlated positively with changes

Table 1 Participants' characteristics at baseline

	CG ($n=23$)	RT1 ($n=26$)	RT2 ($n=27$)	RT3 ($n=28$)	p^a
Gender: female (%)	47.8	53.8	59.6	57.1	.864
Age (year)	68.3 (2.3)	68.9 (2.7)	67.7 (2.8)	69.0 (3.3)	.282
Education (%)					.091
Basic comprehensive school	30.4	32.0	15.4	53.6	
Upper secondary education	21.7	32.0	42.3	25.0	
Tertiary education	47.8	36.0	42.3	21.4	
Marital status (%)					.945
Married/cohabitation	73.9	76.0	80.8	78.6	
Single/divorced/widowed	26.1	24.0	19.2	21.4	
Weight (kg)	74.5 (11.6)	76.5 (14.5)	80.6 (14.1)	81.5 (14.7)	.235
Height (cm)	167.5 (8.7)	166.8 (8.7)	167.9 (7.3)	167.4 (9.3)	.976
BMI (kg/m^2)	26.4 (2.6)	27.3 (3.3)	28.6 (4.4)	29.0 (4.1)	.070
Aerobic training min/week	110.0 (62.7)	113.2 (63.6)	110.8 (56.1)	84.6 (58.3)	.143

Mean and standard deviations or frequencies presented

CG = control group, *RT1-3* = resistance training one, two or three times-a-week groups

[a]Differences between groups tested by ANOVA for continuous variables and Chi-Square test for categorical variables

Table 2 Means and standard deviations (SD) of quality of life (QoL), sense of coherence (SoC), and depressive symptoms (DS) at baseline, month-3, and month-9, and effect sizes for mean changes between the groups

	Baseline mean (SD)	Month-3 mean (SD)	Month-9 mean (SD)	ΔEffect size (95% CI) 0–3	ΔEffect size (95% CI) 3–9	ΔEffect size (95% CI) 0–9
Physical QoL						
CG ($n=23, 21, 20$)[a]	16.6 (2.1)	16.7 (1.6)	16.7 (1.8)	Ref.	Ref.	Ref.
RT1, RT2 and RT3 ($n=78, 79$)	16.8 (1.7)	17.2 (1.7)[b]		.44 (−.05, .92)		
RT1 ($n=25, 25, 25$)	17.2 (1.7)	17.5 (1.7)	17.6 (1.6)		−.09 (−.69, .51)	.31 (−.29, .90)
RT2 ($n=26, 27, 26$)	16.7 (1.7)	17.1 (1.4)	17.1 (1.7)		−.06 (−.65, .54)	.26 (−.33, .85)
RT3 ($n=28, 26, 28$)	16.5 (1.8)	16.8 (2.1)	16.6 (2.3)		−.22 (−.81, .38)	.12 (−.46, .69)
Psychological QoL						
CG	15.4 (1.9)	16.1 (1.6)	16.1 (1.5)	Ref.	Ref.	Ref.
RT1, RT2 and RT3	16.1 (2.0)	16.6 (1.9)[b]		.09 (−.40, .57)		
RT1	16.4 (1.9)	16.8 (1.7)	17.1 (1.8)[d]		.08 (−.53, .68)	.30 (−.31, .89)
RT2	16.0 (1.7)	16.5 (1.7)	16.7 (1.8)[d]		.03 (−.56, .62)	.35 (−.25, .94)
RT3	15.9 (2.4)	16.6 (2.3)	16.3 (2.3)		−.18 (−.77, .41)	.17 (−.40, .74)
Social QoL						
CG	14.3 (2.4)	14.6 (2.9)	14.6 (3.0)	Ref.	Ref.	Ref.
RT1, RT2, and RT3	15.2 (2.5)	15.0 (2.9)		.01 (−.47, .49)		
RT1	14.8 (2.7)	14.5 (2.9)	14.6 (2.5)		.05 (−.55, .65)	.09 (−.51, .68)
RT2	15.8 (1.9)	15.1 (2.8)	14.8 (2.4)[d]		−.03 (−.62, .56)	.24 (−.83, .35)
RT3	15.0 (2.8)	15.4 (3.0)	14.1 (2.9)[c]		−.35 (−.94, .25)	−.17 (−.74, .41)
Environmental QoL						
CG	16.6 (1.7)	16.5 (1.7)	16.4 (2.0)	Ref.	Ref.	Ref.
RT1, RT2, and RT3	16.8 (1.7)	17.0 (2.0)		.38 (−.11, .86)		
RT1	17.2 (1.7)	17.7 (1.5)	17.2 (1.6)		−.43 (−1.03, .19)[e]	.23 (−.37, .82)
RT2	16.8 (1.2)	16.9 (1.7)	17.6 (1.4)[d]		.40 (−.20, .99)	.85 (.23, 1.45)[f]
RT3	16.4 (2.0)	16.5 (2.4)	16.5 (2.3)		.14 (−.45, .73)	.39 (−.19, .97)
SoC						
CG	71.3 (6.5)	72.0 (7.0)	72.5 (7.8)	Ref.	Ref.	Ref.
RT1, RT2, and RT3	72.8 (1.5)	75.5 (9.8)[b]		.30 (−.18, .79)		
RT1	75.8 (10.1)	77.9 (9.6)	79.7 (10.0)[d]		−.06 (−.67, .54)	.48 (−.13, 1.07)
RT2	7.2 (11.2)	74.3 (8.9)	77.0 (7.0)[c, d]		.22 (−.37, .81)	.85 (.22, 1.44)[g]
RT3	72.6 (9.9)	74.4 (10.8)	74.8 (10.3)		−.11 (−.70, .48)	.28 (−.30, .85)
DS						
CG	5.0 (2.9)	4.1 (3.2)[b]	3.6 (3.6)[d]	Ref.	Ref.	Ref.
RT1, RT2, and RT3	4.5 (3.7)	3.3 (3.4)[b]		−.12 (−.60, .36)		
RT1	3.7 (3.7)	3.5 (4.2)	3.4 (3.5)		.19 (−.41 to .79)	.36 (−.24, .96)
RT2	4.7 (3.6)	3.5 (2.6)	3.0 (2.9)[d]		.02 (−.57, .61)	.08 (−.66, .51)
RT3	5.0 (3.8)	2.9 (3.3)	3.1 (3.2)[d]		.34 (−.26, .93)	−.24 (−.82, .34)

Significant ($p<.05$) difference within group between [b]Baseline and month-3, [c]Month-3 and month-9, [d]Baseline and month-9

CG control group, *RT1-3* resistance training one, two or three times a week groups, *Ref.* reference group

[a]Sample sizes for baseline, month-3 and month-9, respectively. All outcomes have the same sample size

Table 2 (continued)

[e]Effect size compared to RT2 −0.78 (−1.34 to −0.19) and to RT3 −0.54 (−1.09 to 0.03)

[f]Effect size compared to RT1 0.60 (0.01–1.16) and to RT3: 0.59 (0.03–1.13)

[g]Effect size compared to RT3: 0.65 (0.09–1.20)

Table 3 The effect of intervention on quality of life (QoL), sense of coherence (SoC), and depressive symptoms (DS), analyzed by generalized estimated equations (GEE)

	GEE model 0–3[a]			GEE model 3–9[b]			GEE model 0–9[c]		
	Group *p*	Time *p*	Group × time *p*	Group *p*	Time *p*	Group × time *p*	Group *p*	Time *p*	Group × time *p*
Physical QoL	.570	.087	.064	.276	.662	.828	.291	.323	.685
Psychological QoL	.262	< .001	.814	.439	.832	.421	.161	< .001	.521
Social QoL	.543	.276	.722	.886	.080	.493	.520	.004	.740
Environmental QoL	.578	.308	.048	.076	.469	.025[d]	.260	.228	.011[e]
SoC	.241	.002	.110	.057	.178	.550	.222	< .001	.032[f]
DS	.722	< .001	.840	.912	.348	.429	.979	< .001	.201

Models adjusted by mean aerobic physical activity (min/week) from [a]months 1–3, [b]months 4–9, and [c]months 1–9. [d]RT1 had significant differences compared to RT2 ($p = .005$) and RT3 ($p = .036$). [e]RT2 had significant differences compared to CG ($p = .001$), RT1 ($p = .047$) , and RT3 ($p = .043$). [f]RT2 had significant differences compared to CG ($p = .006$) and RT3 ($p = .017$)

in maximum strength, so it is possible that initial improvements in strength contributed to the participants' abilities to use their environment. Environmental dimension of QoL includes questions related to home environmental, physical safety, but also (importantly in the context of the present study) the individual's possibility to access leisure activities, health services, and public transport [1]. It is possible that this dimension measures partly similar concepts related to improved functional capacity as the physical dimension, which was borderline statistically significant after 3 months of training. While there was a positive relationship between changes in environmental QoL and strength, the relationship was weak ($r^2 = 0.04$), and no relationships were noted for changes in functional capacity. Consequently, the satisfaction of one's own capabilities in relation to the environment seems not entirely dependent on actual physical changes.

Regarding SoC, the results suggest that SoC improved in the training group after 3 months of training, but the change was not statistically significant compared to CG. However, when comparing the change from baseline to month-9, SoC improved among RT2 compared to CG and RT3. According to these results, it seems that changes in SoC develop slowly, and that the RT intervention needs to be longer than 3 months. SoC is described to be stable and enduring, but not an unchangeable life orientation [6, 40, 41]. Exercise is one of the resources contributing to good SoC [6, 42, 43]: it seems that physical activity can contribute to SoC, but it has to be regular and continuous, part of a lifestyle, to bring about a change. Both SoC and environmental QoL are important health-promoting resources and closely related to overall well-being of older adults [1, 8]. As the results of the present study indicate that RT is a potential way to improve these relative stable constructs, the importance of RT in promoting both physical and psychological health should be better taken into account.

Previously, two studies observed no differences in the change in QoL between RT frequencies [28, 29]. The results of the present study showed that training twice a week was the most effective frequency to increase environmental QoL and SoC, which were not measured in those previous studies. It seems that improvements in environmental QoL and SoC could not be solely due to improvements in physical functioning and strength; otherwise, also RT3 should have improved during the 9-month period. One explanation for this could be that among previously sedentary older adults, three high-intensive RT sessions per week were too much for their psychological functioning: for example, meta-analysis by Arent et al. [44] showed that exercise interventions with training frequency less than three times a week were more beneficial to older adults' mood than interventions with three or more session per week. Another explanation could be regularity and continuity: perhaps continuing with the same training frequency throughout the intervention was the key element for improvements in RT2. It is possible that a reduced training frequency for the last 6 months have led to the feeling of the loss of benefits, whereas increasing training frequency may have been perceived as too much. It could be speculated that continuing RT with the same frequency over 9 months may have offered a sufficient feeling of continuity. In future, studies investigating the effect of different training frequencies on different areas of psychological functioning should start the intervention directly

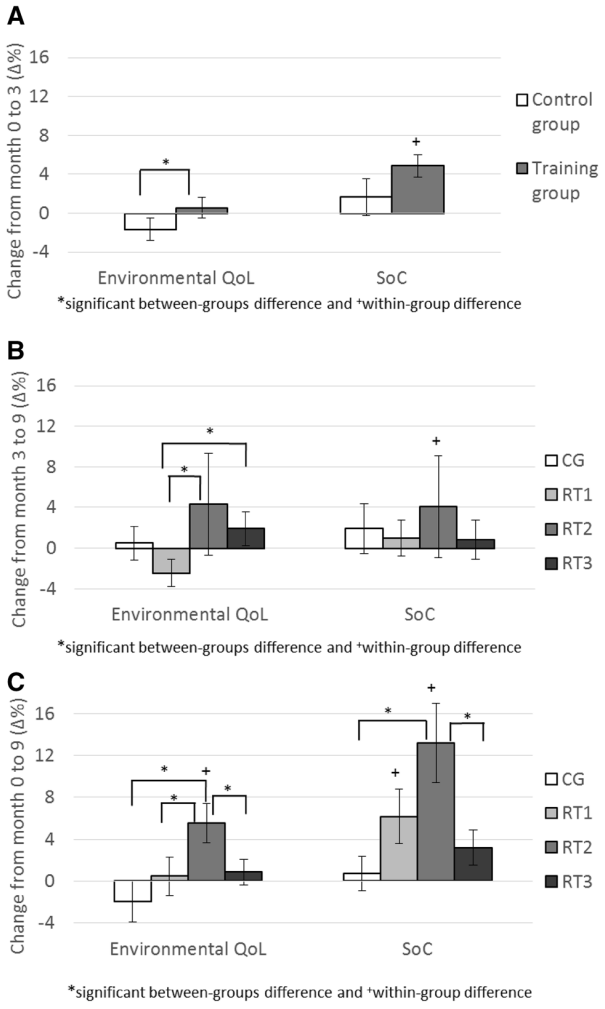

Fig. 2 Study key findings: changes in environmental quality of life (QoL) and sense of coherence (SoC) (mean and SE). *CG* control group, *RT1-3* resistance training one-, two-, or three-times-a-week group

with different frequencies to determine possible between-group differences from the initiation. In addition, it would be important to investigate the effect of changes in training frequency in relation to psychological functioning, because it is quite common in practice to have, e.g., seasonal variation in training [45].

During the initial 3 months of RT, physical and psychological QoL increased and DS decreased in the training group, and in psychological QoL and DS these changes remained to the end of the intervention. These findings are in line with some previous studies, where both shorter (≤3 months) [18, 19, 46–48] and longer (≥6 months) [20, 25, 49] RT interventions have had positive effects on physical and psychological QoL and DS. On the other hand, RT does not affect QoL according to some previous studies [21–23]. The inconsistent results regarding QoL may be due to differences between studies: for instance, in studies where no intervention effect on QoL occurred [21–23], participants where younger than in those studies where improvements were observed [18–20, 25, 46–49]. Damush and Damush [23] observed that both training and control group seemed to improve in health-related QoL measurements, possibly because the control group was also allocated to social interaction. In the present study, CG was not allocated to social interaction, but they increased their aerobic exercise despite the instructions not to change their lifestyle. These findings may indicate that the participants in the present study were all motivated to improve their health/well-being and may have influenced the findings. For instance, a decrease in DS occurred also in CG. Although the GEE analyses were adjusted by the amount of aerobic training, this lifestyle change may explain why there were no intervention effects on these variables.

These results also suggest that apart from SoC, the largest changes in QoL and DS seemed to occur in the beginning of RT. This is in line with the results of two meta-analyses showing that shorter exercise programs are more effective for psychological functioning than longer ones among older adults [14, 44]. It is possible that individuals perceive

Table 4 Pearson's correlations (*r*-values) between changes in quality of life (QoL), depressive symptoms (DS), sense of coherence (SoC), strength and functional capacity: changes between baseline and month-3 above diagonal and between baseline and month-9 below diagonal

Absolute change	1	2	3	4	5	6	7	8[a]
1. Physical QoL	–	.33**	.18	.37***	−.23*	.18	.21*	−.00
2. Psychological QoL	.42***	–	.08	.25*	−.25*	.26**	.08	−.02
3. Social QoL	.23*	.13	–	.12	−.03	−.10	.13	−.09
4. Environmental QoL	.47***	.35***	.04	–	.08	.06	.22*	−.01
5. DS	−.19	−.29**	.00	−.22*	–	−.08	.02	.06
6. SoC	.31**	.25**	.01	.19	−.34**	–	.04	.13
7. Strength	.04	.10	.07	.16	−.10	.05	–	−.28*
8. Functional capacity[a]	.07	.08	−.01	−.00	−.09	.06	−.19	–

*$p < .05$, **$p < .01$, ***$p < .001$

[a]Negative change means better functional capacity

physical benefits of exercise even after short-term training and these improvements in turn contribute to better psychological functioning [14]. This would seem logical given that the largest gains in physical function occur at the beginning of a training intervention and these gains plateau after some months [12], as was also the case in this intervention [31, 32]. In the present intervention, correlations indicate that improvements in strength are slightly associated with psychological functioning after 3 months of intervention, but not after 9 months. It seems that, especially longitudinally, the relationship between exercise and psychological functioning is more complicated; in addition to improvements in physical functioning, there are many other possible mediators that could explain the relationship [17]. Social interaction, master experiences and self-efficacy, stress-removal, and hormonal changes are possible mediators [14, 17]. These mechanisms between RT and psychological functioning may be a fruitful area for future research, since they are not well understood. There is evidence that psychological improvements return to baseline after an intervention, especially among those participants who do not continue RT after the intervention [19, 50]. Therefore, it is important to encourage older adults to participate in RT after the intervention to maintain improvements in psychological functioning also.

The results of this study show that RT influences some areas of psychological functioning but not all. It is also possible that high baseline scores have produced a ceiling effect. At baseline, the QoL domain scores were higher than average in the corresponding age group [2], SoC scores were in the upper part of a range found in a systematic review [35], and the amount of DS was low in the present study with only 2% scoring over 13 (threshold for mild depression [36]). It is probable that individuals with normal levels of functioning and high baseline health-related QoL scores may not benefit from exercise as much as those with lower baseline scores [13]. In addition, this was a secondary analysis of randomized controlled trial and the power analyses were based on muscle strength and functional capacity, so it is also possible that the trial was unpowered to detect changes in psychological functioning. Nevertheless, previous studies have found significant changes in psychological functioning with similar or even smaller sample sizes [13, 28]. Despite these possible limitations, we still observed changes in environmental QoL and SoC, which gives confidence that these observations reflect true phenomena derived from the RT intervention of the present study. The high baseline scores may also indicate that the present study sample consisted largely of older adults with good psychological functioning and motivation to start training. It is not clear why those with low QoL, weak SoC, and DS did not register to participate in the RT intervention of the present study. In addition, the sample consisted of healthy older adults aged 65–75; hence, the results should be replicated among participants with a wider age range and different patient groups.

In conclusion, the key observation of this study is that, in addition to well-known physical benefits for aged populations, RT is beneficial for environmental QoL and SoC. Future studies should investigate the cause(s) of these improvements in psychological functioning; for instance, are they consequences of changes in physical characteristics or other psychological constructs? Future trials should also consider training frequency and duration in relation to RT and psychological functioning: identifying when the changes occur, and the appropriate intervention duration and quantity needed to gain the benefits.

Funding This work was supported by the Ministry of Education and Culture of Finland (OKM/56/626/2014). The sponsor had no involvement in the design, participant recruitment, data collection, analysis, or preparation of this paper.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. World Health Organization. (1998). Development of the World Health Organization WHOQOL-BREF quality of life assessment. The WHOQOL Group. *Psychological Medicine, 28*(3), 551–558.
2. Skevington, S. M., Lotfy, M., & O'Connell, K. A. & WHOQOL Group. (2004). The World Health Organization's WHOQOL-BREF quality of life assessment: Psychometric properties and results of the international field trial. A report from the WHOQOL group. *Quality of Life Research, 13*(2), 299–310.
3. Eriksson, M., & Lindstrom, B. (2007). Antonovsky's sense of coherence scale and its relation with quality of life: A systematic review. *Journal of Epidemiology and Community Health, 61*(11), 938–944.
4. Sivertsen, H., Bjørkløf, G. H., Engedal, K., Selbæk, G., & Helvik, A. (2015). Depression and quality of life in older persons: A review. *Dementia and Geriatric Cognitive Disorders, 40*(5–6), 311–339.

5. Chachamovich, E., Fleck, M., Laidlaw, K., & Power, M. (2008). Impact of major depression and subsyndromal symptoms on quality of life and attitudes toward aging in an international sample of older adults. *The Gerontologist, 48*(5), 593–602.
6. Antonovsky, A. (1987). *Unraveling the mystery of health: How people manage stress and stay well*. San Fransisco: Jossey-Bass.
7. Castro-Costa, E., Dewey, M., Stewart, R., Banerjee, S., Huppert, F., Mendonca-Lima, C., et al. (2007). Prevalence of depressive symptoms and syndromes in later life in ten European countries: The SHARE study. *The British Journal of Psychiatry: The Journal of Mental Science*. https://doi.org/10.1192/bjp.bp.107.036772.
8. Eriksson, M., & Lindström, B. (2006). Antonovsky's sense of coherence scale and the relation with health: A systematic review. *Journal of Epidemiology and Community Health*. https://doi.org/10.1136/jech.2005.041616.
9. World Health Organization. (2010). Global recommendations on physical activity for health. Geneva: World Health Organization.
10. Bennie, J. A., Pedisic, Z., Suni, J. H., Tokola, K., Husu, P., Biddle, S. J., et al. (2017). Self-reported health-enhancing physical activity recommendation adherence among 64,380 Finnish adults. *Scandinavian Journal of Medicine & Science in Sports*. https://doi.org/10.1111/sms.12863.
11. Hunter, G. R., McCarthy, J. P., & Bamman, M. M. (2004). Effects of resistance training on older adults. *Sports Medicine, 34*(5), 329–348.
12. Latham, N. K., Bennett, D. A., Stretton, C. M., & Anderson, C. S. (2004). Systematic review of progressive resistance strength training in older adults. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 59*(1), 48–61.
13. Rejeski, W. J., & Mihalko, S. L. (2001). Physical activity and quality of life in older adults. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 56*(2), pp. 23–35.
14. Netz, Y., Wu, M. J., Becker, B. J., & Tenenbaum, G. (2005). Physical activity and psychological well-being in advanced age: A meta-analysis of intervention studies. *Psychology and Aging, 20*(2), 272–284.
15. Gillison, F. B., Skevington, S. M., Sato, A., Standage, M., & Evangelidou, S. (2009). The effects of exercise interventions on quality of life in clinical and healthy populations; a meta-analysis. *Social Science & Medicine*. https://doi.org/10.1016/j.socscimed.2009.02.028.
16. Rhyner, K. T., & Watts, A. (2016). Exercise and depressive symptoms in older adults: A systematic meta-analytic review. *Journal of Aging and Physical Activity*. https://doi.org/10.1123/japa.2015-0146.
17. McAuley, E., & Rudolp, D. (1995). Physical activity, aging and psychological well-being. *Journal of Aging and Physical Activity, 3*, 67–96.
18. Ramirez-Campillo, R., Castillo, A., de la Fuente, C. I., Campos-Jara, C., Andrade, D. C., Alvarez, C., et al. (2014). High-speed resistance training is more effective than low-speed resistance training to increase functional capacity and muscle performance in older women. *Experimental Gerontology, 58*, 51–57.
19. de Vreede, P. L., van Meeteren, N. L., Samson, M. M., Wittink, H. M., Duursma, S. A., & Verhaar, H. J. (2007). The effect of functional tasks exercise and resistance exercise on health-related quality of life and physical activity. A randomised controlled trial. *Gerontology, 53*(1), 12–20.
20. Wanderley, F. A. C., Oliveira, N. L., Marques, E., Moreira, P., Oliveira, J., & Carvalho, J. (2013). Aerobic versus resistance training effects on health-related quality of life, body composition, and function of older adults. *Journal of Applied Gerontology, 34*(3), 143–165.
21. Sillanpaa, E., Hakkinen, K., Holviala, J., & Hakkinen, A. (2012). Combined strength and endurance training improves health-related quality of life in healthy middle-aged and older adults. *International Journal of Sports Medicine, 33*(12), 981–986.
22. Bonganha, V., Modeneze, D. M., Madruga, V. A., & Vilarta, R. (2012). Effects of resistance training (RT) on body composition, muscle strength and quality of life (QoL) in postmenopausal life. *Archives of Gerontology and Geriatrics, 54*(2), 361–365.
23. Damush, T. M., & Damush, J. G. J. (1999). The effects of strength training on strength and health-related quality of life in older adult women. *The Gerontologist, 39*(6), 705–710.
24. Pakkala, I., Read, S., Sipila, S., Portegijs, E., Kallinen, M., Heinonen, A., et al. (2012). Effects of intensive strength-power training on sense of coherence among 60-85-year-old people with hip fracture: A randomized controlled trial. *Aging Clinical and Experimental Research, 24*(3), 295–299.
25. Kohut, M. L., McCann, D. A., Russell, D. W., Konopka, D. N., Cunnick, J. E., Franke, W. D., et al. (2006). Aerobic exercise, but not flexibility/resistance exercise, reduces serum IL-18, CRP, and IL-6 independent of β-blockers, BMI, and psychosocial factors in older adults. *Brain, Behavior, and Immunity, 20*(3), 201–209.
26. O'Connor, P. J., Herring, M. P., & Caravalho, A. (2010). Mental health benefits of strength training in adults. *American Journal of Lifestyle Medicine, 4*(5), 377–396.
27. Dunn, A. L., Trivedi, M. H., & O'Neal, H. A. (2001). Physical activity dose-response effects on outcomes of depression and anxiety. *Medicine and Science in Sports and Exercise, 33*, S587–S597.
28. Ramirez-Campillo, R., Diaz, D., Martinez-Salazar, C., Valdés-Badilla, P., Delgado-Floody, P., Méndez-Rebolledo, G., et al. (2016). Effects of different doses of high-speed resistance training on physical performance and quality of life in older women: A randomized controlled trial. *Clinical Interventions in Aging, 11*, 1797–1804.
29. Benton, M. J., & Schlairet, M. C. (2012). Improvements in quality of life in women after resistance training are not associated with age. *Journal of Women & Aging, 24*(1), 59–69.
30. Walker, S., Haff, G. G., Häkkinen, K., & Newton, R. U. (2017). Moderate-load muscular endurance strength training did not improve peak power or functional capacity in older men and women. *Frontiers in Physiology*. https://doi.org/10.3389/fphys.2017.00743.
31. Fernandez-Lezaun, E., Schumann, M., Makinen, T., Kyrolainen, H., & Walker, S. (2017). Effects of resistance training frequency on cardiorespiratory fitness in older men and women during intervention and follow-up. *Experimental Gerontology*. https://doi.org/10.1016/j.exger.2017.05.012.
32. Turpela, M., Hakkinen, K., Haff, G. G., & Walker, S. (2017). Effects of different strength training frequencies on maximum strength, body composition and functional capacity in healthy older individuals. *Experimental Gerontology*. https://doi.org/10.1016/j.exger.2017.08.013.
33. Liu, C. J., & Latham, N. K. (2009). Progressive resistance strength training for improving physical function in older adults. *The Cochrane Database of Systematic Reviews, 3*(3), CD002759.
34. von Steinbüchel, N., Lischetzke, T., Gurny, M., & Eid, M. (2006). Assessing qualify of life in older people: Psychometric properties of the WHOQOL-BREF. *European Journal of Ageing, 3*(2), 116–122.
35. Eriksson, M., & Lindström, B. (2005). Validity of Antonovsky's sense of coherence scale: A systematic review. *Journal of Epidemiology and Community Health, 59*(6), 460–466.
36. Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck Depression Inventory-II*. San Antonio, TX: Psychological Corporation.
37. Wang, Y. P., & Gorenstein, C. (2013). Psychometric properties of the Beck Depression Inventory-II: A comprehensive review. *Revista Brasileira De Psiquiatria, 35*(4), 416–431.

38. Zhang, S., Cao, J., & Ahn, C. (2014). A GEE approach to determine sample size for pre- and post-intervention experiments with dropout. *Computational Statistics & Data Analysis*. https://doi.org/10.1016/j.csda.2013.07.037.
39. Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155–159.
40. Feldt, T., Lintula, H., Suominen, S., Koskenvuo, M., Vahtera, J., & Kivimaki, M. (2007). Structural validity and temporal stability of the 13-item sense of coherence scale: Prospective evidence from the population-based HeSSup study. *Quality of Life Research, 16*(3), 483–493.
41. Hakanen, J. J., Feldt, T., & Leskinen, E. (2007). Change and stability of sense of coherence in adulthood: Longitudinal evidence from the Healthy Child study. *Journal of Research in Personality, 41*(3), 602–617.
42. Hassmén, P., Koivula, N., & Uutela, A. (2000). Physical exercise and psychological well-being: A population study in Finland. *Preventive Medicine*. https://doi.org/10.1006/pmed.1999.0597.
43. Read, S., Aunola, K., Feldt, T., Leinonen, R., & Ruoppila, I. (2005). The relationship between generalized resistance resources, sense of coherence, and health among Finnish people aged 65–69. *European Psychologist, 10*(3), 244–253.
44. Arent, S. M., Landers, D. M., & Etnier, J. L. (2000). The effects of exercise on mood in older adults: A meta-analytic review. *Journal of Aging and Physical Activity, 8*(4), 407–430.
45. Matthews, C. E., Freedson, P. S., Hebert, J. R., Stanek, III E. J., Merriam, P. A., Rosal, M. C., et al. (2001). Seasonal variation in household, occupational, and leisure time physical activity: Longitudinal analyses from the seasonal variation of blood cholesterol study. *American Journal of Epidemiology*. https://doi.org/10.1093/aje/153.2.172.
46. Levinger, I., Goodman, C., Hare, D. L., Jerums, G., & Selig, S. (2007). The effect of resistance training on functional capacity and quality of life in individuals with high and low numbers of metabolic risk factors. *Diabetes care, 30*(9), 2205–2210.
47. Levinger, I., Selig, S., Goodman, C., Jerums, G., Stewart, A., & Hare, D. (2011). Resistance training improves depressive symptoms in individuals at high risk for type 2 diabetes. *Journal of Strength and Conditioning Research*. https://doi.org/10.1519/JSC.0b013e3181f8fd4a.
48. Singh, N. A., Stavrinos, T. M., Scarbek, Y., Galambos, G., Liber, C., & Fiatarone Singh, M. A. (2005). A randomized controlled trial of high versus low intensity weight training versus general practitioner care for clinical depression in older adults. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*. https://doi.org/10.1093/gerona/60.6.768.
49. Ohira, T., Schmitz, K. H., Ahmed, R. L., & Yee, D. (2006). Effects of weight training on quality of life in recent breast cancer survivors: The Weight Training for Breast Cancer Survivors (WTBS) study. *Cancer*. https://doi.org/10.1002/cncr.21829.
50. Inaba, Y., Obuchi, S., Arai, T., Satake, K., & Takahira, N. (2008). The long-term effects of progressive resistance training on health-related quality in older adults. *Journal of Physiological Anthropology, 27*(2), 57–61.

IV

MOTIVATIONAL CHARACTERISTICS AND RESISTANCE TRAINING IN OLDER ADULTS: A RANDOMIZED CONTROLLED TRIAL AND 1-YEAR FOLLOW-UP

by

Kekäläinen T, Kokko K, Tammelin T, Sipilä S, Walker S. 2018

Scandinavian Journal of Medicine & Science in Sports 28 (11): 2416-2426

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Article type : Original Article

Motivational characteristics and resistance training in older adults: a randomized controlled trial and 1-year follow-up

Running title: Motivation and resistance training

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This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/sms.13236

Motivational characteristics and resistance training in older adults: a randomized controlled trial and 1-year follow-up

Abstract

The aim of this study was to investigate the effects of a nine-month supervised resistance training intervention on motivational and volitional characteristics related to exercise, and whether the absolute level and/or intervention-induced change in these characteristics predict self-directed continuation of resistance training one year after the intervention. Community-dwelling older adults aged 65-75, who did not fulfill physical activity recommendations, were randomized into resistance training intervention groups: training once- (n=26), twice- (n=27), three-times-a-week (n=28) or non-training control group (n=25). Training groups participated in supervised resistance training for nine months: during months 1-3 all groups trained twice-a-week and then with allocated frequencies during months 4-9. Exercise-related motivation, self-efficacy and planning were measured with questionnaires at baseline, month-3 and month-9. The continuance of resistance training was determined by interviews six and twelve months after the end of the intervention. The intervention improved action and coping planning as well as intrinsic motivation (group×time $p<.05$). During one-year follow-up, 54% of participants did not continue self-directed regular resistance training, 22% continued regular resistance training once-a-week and 24% twice-a-week. Increases in exercise self-efficacy and intrinsic motivation related to training during the intervention predicted continuation of resistance training twice-a-week. Resistance training improved exercise-related motivational and volitional characteristics in older adults. These improvements were linked to continuing resistance training one year after the supervised intervention. The role of these characteristics should be taken into account when promoting long-term resistance training participation among older adults.

Keywords: motivation, volition, strength training, exercise, physical activity, aging

INTRODUCTION

Regular and progressive resistance training (RT) offers major benefits to older adults' physical functioning and health, such as maintaining and increasing muscle mass, strength and power.[1-3] According to both the American College of Sport Medicine[4] and Finnish national physical activity recommendations,[5] older adults should participate in muscle-strengthening activities at least twice-a-week. However, in Finland, only 11% of older adults aged 65-74 report meeting these recommendations.[6] Hence, understanding the possible reasons for non-participation and participation in RT are important.

There are many theories explaining the potential psychological reasons for participating in exercise, and motivation is one of the key characteristics behind a behavior.[7,8] According to self-determination theory by Ryan and Deci,[8] motivation can arise from the satisfaction and pleasure of the activity itself (intrinsic motivation) or from extrinsic outcomes achieved via the activity (extrinsic motivation). Motivation is seen as a continuum from more extrinsic motivation to more intrinsic and autonomous motivation.[8] In the Health Action Process Approach (HAPA) by Schwarzer, motivation is distinguished from volition: the motivational phase leads to intention and secondly, the volitional phase leads to actual behavior.[9] In the volitional phase, implementing intentions is closely related to

action planning, which includes planning when, where and how to exercise, as well as coping planning, which describes how difficult situations will be confronted.[9,10] Both of these have been shown to be predictors of exercise adherence.[11] In addition, self-efficacy is needed in both motivational and volitional phases.[9,12] Based on Bandura´s social cognitive theory, self-efficacy describes how confident an individual is about their abilities to succeed in different situations or tasks.[13] High self-efficacy is linked to commitment and intrinsic motivation.[13] Related to health-enhancing behavior, self-efficacy reflects, for instance, capabilities to perform an action and to overcome different barriers (coping self-efficacy).[9,12]

Although exercise-related motivational and volitional characteristics have been shown to be determinants of exercise participation,[11,14,15] much less is known specifically regarding RT. Winett et al.[16,17] suggest that RT may require a specific set of beliefs compared to other physical activities because of its nature. For example, confidence to lift external loads and increase the training-load regularly is a specific requirement in RT. Nevertheless, there is some evidence that exercise self-efficacy is also closely related to RT; exercise self-efficacy beliefs have been associated with the continuance of RT after intervention in older adults,[18] but not in all studies.[19]

Interestingly, there is some evidence that the association between motivational and volitional characteristics and RT may be bi-directional; these characteristics are related to adoption and continuance of physical activity, but also RT in itself may be able to improve these characteristics. For example, RT has had a positive effect on confidence to lift external loads in older adults [20] and on exercise self-efficacy in younger adults.[21] In addition, there is evidence that RT interventions lasting 12-week (three times-a-week) can improve introjected, identified and intrinsic motivation for exercise.[22,23] However, it is currently unclear whether RT training frequency influences these findings in older adults.

Therefore, the purpose of this study was to; 1) investigate the effects of a nine-month RT intervention with different training frequencies on exercise-related motivational and volitional characteristics, assessed here by motivation, self-efficacy, action and coping planning, and 2) investigate whether their absolute level and/or intervention-induced change predicted self-directed RT continuance one year after the intervention. Based on the review of the literature, it was hypothesized that RT will improve motivational and volitional characteristics in older adults and that higher levels of exercise motivation and self-efficacy predict RT continuance after the intervention. The present study was a secondary analysis of a randomized controlled trial “Get in Shape in the Team Research” (Clinical trials (clinicaltrials.gov) register number NCT02413112). Previous studies that have published the physical outcomes of the trial showed that maximum strength[24] and cardiorespiratory fitness[25] improved after 3 months of training, and a higher training frequency provided greater benefit for maximum dynamic strength, but not for functional capacity, over the 9–month intervention.[26]

METHODS

Study design and participants

This study was a secondary analysis of a parallel-group randomized controlled trial. Ethical approval for the study was obtained from the Ethical Committee of the University of Jyväskylä and all participants signed written informed consent prior to participation. The study design, participants and intervention have been described in detail in previous studies.[24,26] Participants were randomly assigned to four groups: RT once-a-week (RT1 n=26), RT twice-a-week (RT2 (n=27), RT three times-a-week (RT3 n=28) and non-training control group (CG, n=25). Pre-trial power analysis for primary outcomes of the study (maximum strength and functional capacity) was based on the effect sizes reported in a meta-analysis by Liu and Latham.[1] With a 75:25 intervention-to-control ratio, a sample size of 60 for strength and 88 for functional capacity was sufficient to reach 80% probability to observe treatment difference with a 5% level of significance.

The flow diagram of the study is shown in Figure 1. Participants were selected by random sampling from a population register of community-dwelling older adults aged 65-75 living in the Jyväskylä area. Recruitment occurred in October-December 2014. Inclusion criteria were; 1) leisure-time aerobic exercise less than 3 hours/week, 2) no previous regular RT experience, 3) BMI<37, 4) no previous testosterone-altering treatment, 5) no serious cardiovascular disease that may affect participating in RT, 6) no medication related to the neuromuscular or endocrine systems, 7) capability to walk without walking aids and 8) no smoking. Two thousand invitation letters were sent with a response rate of 23% (n=454). Those who met the inclusion criteria (n=148) were invited to an information session and 116 participants attended a physician's examination: eight persons were excluded because of medical reasons and two persons were not interested in participating. Hence, 106 participants remained for randomization. Randomization and allocation were made by the principal investigator of the study who was not involved in data collection. Randomization was performed by an online random number generator in a block of 100 participants for four groups, 25 participants for each. Because it was assumed that higher training frequency is likely to increase non-compliance and drop-out rates, three participants were randomized to RT3, two to RT2 and one to RT1 from the remaining six participants. Two participants dropped out from CG because of the randomization result.

Intervention

Training groups (RT1, RT2, and RT3) participated in a nine-month supervised whole-body RT intervention at the Faculty of Sport and Health Sciences gym, University of Jyväskylä. The exact training program has been previously reported[24,26], but briefly, each one hour training session included a 10-min warm-up and 8-9 exercises for different muscle groups (e.g. leg press, knee extension and flexion, chest press, pulldown, pushdown, pec deck, ab crunch. back extension) and was supervised by trained personnel. All training groups followed an alternating two-session training program throughout the intervention. *Months 1-3:* To become familiar with RT and to build capacity for high-load RT, all training groups (RT1, RT2 and RT3) participated in supervised RT twice-a-week for the first three months. The focus of this initial period was on muscular endurance using low loads, with participants performing 2-3 sets of 14-20 repetitions with 0- to 1-min rest between sets for each exercise. *Months 4-9:* The training groups started to exercise with different frequencies: completing the two-session program took two weeks from RT1, one week from RT2 and RT3

completed three cycles in two weeks. The frequency-specific 6-month training period focused on developing muscle hypertrophy and maximum strength. The participants performed 4-5 sets of 4-12 repetitions with 1-3 minutes rest between sets. CG was instructed not to change their lifestyle during the intervention and after month-9 measurements they had an opportunity to participate in supervised RT twice-a-week for six months.

After the nine-month intervention, participants of the training groups could no longer train in the same gym as during the intervention and had to arrange possible continuance of training by themselves. To lower the threshold to continue training independently, participants were given a list of possible low-cost gyms in the city area from the principal investigator upon completion of the month-9 tests.

Measurements

Motivational and volitional characteristics were measured with computer-based questionnaires related to exercise or physical activity in general (not specifically RT).

Exercise self-efficacy was measured by ten questions developed by Schwarzer: five questions evaluated action and coping self-efficacy [12] and five questions barrier self-efficacy.[27] These scales have satisfactory psychometric properties [12,27] and have been used among Finnish adults and older adults.[28,29] Participants were asked to evaluate how confident they were to maintain exercise in different situations related to adoption (e.g. "even if I have to make a detailed plan to exercise") and to overcome barriers (e.g. "even when I am busy"). The answers were given on a scale from 1 = *very certain I cannot* to 4 = *very certain I can*, and aggregated. Cronbach´s alphas were .91, .92 and .92 at baseline, month-3, and month-9, respectively.

Action planning and coping planning to exercise were both assessed with four questions.[10] Participants were asked whether they had a detailed plan when, where, how and how often to exercise (action planning) and how to combat the different barriers and obstacles to exercise (coping planning). The scale was from 1 = *not at all true* to 4 = *very true*. The scale has good psychometric properties in a wide population age range.[10] Cronbach´s alphas were .89, .90 and .89 for action planning and .90, .91 and .86 for coping planning at baseline, month-3 and month-9, respectively.

Motivation for physical activity and training was measured with the Exercise Self-Regulation Questionnaire (SRQ-E).[30] The questionnaire has shown adequate psychometric properties among different populations.[31-33] The questionnaire has two parts: 16 statements measure motivation regarding physical activity (e.g. "I try, or would like to try, to be physically active regularly because I enjoy physical activities") and 12 statements regarding training (e.g. "I exercise/work out (or would like to work out) because I feel pressure to work out"). The scale was from 1 = *not at all true* to 7 = *very true*. The mean scores for each motivational regulation (external, introjected, identified and intrinsic) were calculated separately for physical activity and training. Cronbach´s alphas showed an adequate fit[34] (range .70-.92) to all four regulation styles for physical activity and to three regulation styles for training. The exception was introjected regulation for training: Cronbach´s alphas were .47 at baseline, .57 at month-3 and .39 at month-9. The three items measuring introjected regulation for training were "I exercise/work out because I would feel bad about myself if I didn´t do it", …"I'd be afraid of falling too far out of shape if I didn't" and …"I feel pressured to work out". Deleting any of these items would not have improved alpha levels.

Leisure-time aerobic exercise was estimated at baseline by a single question specifying the average weekly minutes participants engaged in leisure-time aerobic exercise. During the intervention, diaries tracked daily activities, as well as the duration and intensity of the activities recorded.[35] The average weekly minutes for leisure-time aerobic exercise for months 1-3 and 4-9 were calculated from the diaries.

Continuance of RT: In interviews six months after the intervention ("follow-up 1") and 12 months after the intervention ("follow-up 2"), participants were asked whether they had continued RT. At follow-up 1, the interviews were conducted face-to-face to all training group participants who participated in follow-up strength and functional capacity measurements (n=66). At follow-up 2, interviews were conducted by telephone from all training group participants except the two drop-outs and one participant (from RT3) who was not reachable (n=78). From those who had continued RT, the regularity and average number of RT sessions per ordinary week was asked (common short breaks e.g. because of flu or travel should not be taken into account) in both interviews. Training either individually or in a supervised group was accepted. The average weekly frequency to participate in RT during the year was calculated from values reported in follow-up 1 and follow-up 2. Those who reported that they had continued RT regularly during the year and at least six months twice-a-week and during the other six months once to twice-a-week (average for the year 1.75-2.5 times-a-week) were categorized as twice-a-week continuers. The cut-off value of 1.75 was used because these participants intended to participate in RT twice-a-week (and mostly achieved their intention) but there were some weeks when they trained only once-a-week due to holiday/illness or some other reason. Those who reported that they had continued RT regularly during the year at least once-a-week but not twice-a-week throughout the year (average for the year 1-1.5 times-a-week) were classified as once-a-week continuers. All others, including both participants who had not continued RT at all and participants who had continued less than once-a-week on average (e.g. some participants reported training approx. once-a-month), were classified as non-continuers.

Statistical analysis

Analyses were performed using IBM SPSS Statistics 24.0. A significance level of $p<.05$ was used in all analyses. The first study aim, to investigate the effects of intervention on motivational and volitional characteristics was analyzed by an intention-to-treat principle, with the exception of the two participants that dropped-out immediately after the randomization before baseline measurements for motivational and volitional characteristics. The differences between groups at baseline were analyzed by one-way ANOVA for continuous variables and Chi-Square test for categorical variables. The generalized estimation equation (GEE)–method with an unstructured working correlation matrix was used to analyze group×time differences between groups. Based on the structure of the intervention, three sets of GEE analyses were performed; 1) baseline – month-3 between CG and the training group (RT1, RT2 and RT3), 2) month-3 – month-9, and 3) baseline – month-9 between CG, RT1, RT2 and RT3. Because the amount of leisure-time aerobic exercise (min/week) was not stable in all groups during the intervention (assessed by physical activity diaries), GEE analyses were repeated and adjusted for the amount of leisure-time aerobic exercise. The diaries were missing from seven participants (1 from each RT group and 4 from CG), hence those participants were excluded from the adjusted analyses. The results of analyses with and without aerobic exercise adjustment were similar, therefore only the adjusted GEE results are shown in the Results section. In addition to GEE analyses, the standardized effect sizes for differences in change-scores between groups were

calculated with Cohen´s *d* formula.[36] The changes in motivational and volitional characteristics during the intervention were calculated by subtracting the baseline value from the intervention completion (month-9) value. Within-group differences were analyzed by paired sample t-tests.

The second study aim was to investigate predictors of continuing RT after the intervention. Both the absolute level at post-intervention (month-9) and change during the intervention (month-9 value – baseline value) of motivational and volitional characteristics were analyzed as possible predictors. Differences in possible predictors between non-continuers, once-a-week continuers and twice-a-week continuers were analyzed by one-way ANOVA and Chi-Square tests.

RESULTS

Descriptive statistics

The flow of the participants throughout the study is shown in Figure 1. Three participants dropped out from CG, one from RT1 and one from RT2 (Fig 1).The dropout from RT1 was due to back pain induced by the strength testing in month-6, and other drop-outs occurred due to health (acid reflux events, stress-related high blood pressure, cancer recurrence) or personal issues unrelated to the study.

There were some adverse event, as judged by the investigators, in the study. Adverse effects were collected by self-reports: participants reported more serious ones directly to the principal investigator and documented minor ones in their training diaries. The most serious adverse event was the back pain induced by the strength testing. One participant strained a hamstring muscle walking home after strength measurements at month-3 and could continue the training program but no longer participate in maximum muscle strength measurements. Based on information collected from training diaries, about one third of the participants in training groups had some temporary pain or soreness, for example, in the knee joint, shoulder or back. For these participants the training program was adjusted (e.g. use of lighter loads, modified exercise technique) for a maximum of 2-3 weeks. These discomforts were judged to be part of the adaptation processes, and indeed these feelings were short-term and did not adversely affect participation rates during the 9-month intervention period.

During the first three months of intervention, the training adherence was 97%±4 (range 88-100). [24] During months 4-9, mean adherences were 97%±5 (range 79-100) in RT1, 97%±5 (79-100) in RT2 and 94%±7 (75-100) in RT3. There were no statistically significant differences between groups in adherence rates.

Participants' demographic characteristics and baseline values in motivational and volitional characteristics are presented in **Table 1.** The only significant difference between groups at baseline was in coping planning (ANOVA F(df)=3.30(3), p=.024), which had a higher value in RT1 compared to RT3.

Changes in exercise-related motivational and volitional characteristics during the intervention

The effects of the intervention on motivational and volitional characteristics are presented in **Table 2 and 3.** After three months intervention, there were significant group×time effects for exercise self-efficacy, action and coping planning and intrinsic motivation related to training. From month-3 to month-9 there were no statistically significant between-group differences. Throughout the nine-month intervention, changes occurred in several measured motivational and volitional characteristics. Action planning improved in all training groups compared to CG. Coping planning and intrinsic motivation related to physical activity improved in RT2 and RT3 compared to CG. Both RT2 and RT3 increased their intrinsic motivation related to training and RT2 also introjected regulation related to physical activity compared to CG and RT1. The changes in these variables are shown in **Figure 2**.

Predictors of RT continuance

Of 78 participants, 31 (40%) reported that they did not continue RT at all after the intervention. Five persons (6%) continued RT immediately after the intervention but quit prior to follow-up 1 (6 months after the intervention) and six persons continued RT occasionally (less than once-a-week on average) throughout follow-up (12 months). Therefore, 42 persons (54%) were counted as non-continuers. Seventeen persons (22%) reported to have trained regularly once-a-week on average during the whole year and 19 persons (24%) twice-a-week on average. The average weekly frequency to participate in RT varied between 1.0–2.5 (mean 1.58, SD 0.48). There were no significant differences between intervention groups in continuance rates (Table 4).

The level of motivational and volitional characteristics at post-intervention (month-9) and their change during the intervention (baseline to month-9) were analyzed as possible predictors for continuance of RT (**Table 4**). Twice-a-week continuers had a greater increase in exercise self-efficacy during the intervention than non-continuers and a greater increase in intrinsic motivation related to training compared to both non-continuers and once-a-week continuers.

DISCUSSION

The purpose of this study was to 1) investigate the effects of a RT intervention with the different training frequencies on exercise-related motivational and volitional characteristics, and 2) whether the absolute level and/or change in these characteristics predict self-directed continuance of RT one year after the intervention. RT led to positive changes in exercise self-efficacy, planning and autonomous motivation. Twenty-two percent of participants continued regular RT once-a-week and 24% twice-a-week during the next year after the intervention. A greater increase in exercise self-efficacy and intrinsic motivation related to training during the intervention predicted continuation of RT twice-a-week during follow-up.

The effect of RT on exercise self-efficacy and motivation is in-line with previous studies [20-23,37], indicating that participation in RT intervention can increase self-confidence to maintain exercise behavior and increase intrinsic motivation to exercise in addition to physical outcomes. However, the improvements in exercise self-efficacy diminished after three months in the present study. It is plausible that at month-3 measurements participants were more confident because the intervention

was going to continue but at post-measurements they had started to think about training independently.[38] Action and coping planning in relation to RT have not been studied previously, but the results of the present study suggest that participating in a RT intervention can also increase exercise planning. In relation to motivation, a limitation of this study was that the scale for introjected regulation for training had low internal consistency (alpha values .39-.57). Low alpha reliability implies that the items intended to measure introjected regulation do not measure it in a consistent way in this study sample, even though the scale has had good psychometric properties in previous studies. [31-33] Therefore, the results for introjected regulation for training should be treated with extreme caution.

A possible source for exercise motivation could be the improvements in strength and functional capacity during the intervention.[24-26] However, in the present study, improvements in strength and functional capacity did not influence changes in motivational and volitional characteristics (tested in GEE-analyses adjusted by change in strength and functional capacity, the results not included in the paper). In addition, other characteristics of the intervention may have affected the results. For instance, training in small groups (8-10 persons) and having support/encouragement from the research staff may have affected motivational and volitional characteristics. Hence, even though RT interventions seem to be an effective way to increase intrinsic motivation and planning, it is not clear whether performing RT itself (i.e. without these potential confounding factors) led to these findings. To examine this, the relationship between RT and these characteristics should be studied external to a structured scientific, group-based intervention.

When comparing the results between different training frequencies, there were no differences between groups from month-3 to month-9. It should be noticed, however, that when comparing month-9 results to baseline, RT1 only improved their action planning compared to CG, whereas RT2 and RT3 improved also coping planning and intrinsic motivation related to both physical activity and training. Furthermore, RT2 and RT3 improved their intrinsic motivation related to training also compared to RT1. In support of these findings, effect sizes suggest that training twice- or three times-a-week was related to greater changes in these characteristics over the entire intervention period. It is likely that the structure of the intervention influenced these findings and should be remembered when interpreting the results: all training groups participated in RT twice-a-week during the first three months and then split into different frequencies. This meant that the once-a-week group were forced to reduce their training frequency. Therefore, it is not possible to separate the effects of training frequency per se from the effects of reducing training frequency. In future studies, it should further be investigated whether it is the recommended RT frequency of at least twice-a-week [4] to derive also the most motivational benefits. However, our results suggest that greater resistance training frequency contributes little to improved motivational and volitional characteristics since we did not observed differences from month-3 to month-9 measurements.

Almost half of the participants (46%) continued RT during the one-year follow-up at least once-a-week. The continuation rate is similar to the studies by Geirsdottir et al. [39], in which ~18% of participants continued RT once- or twice-a-week and ~24% ≥three times-a-week, and Inaba et al. [40], in which 43% continued RT at least once-a-week. In both studies the continuation was measured by self-reports. A limitation of the present study is that participants were not able to continue RT in the same gym used during the intervention. Finding a new place to continue RT could have been a significant barrier for some participants and reduced the continuance rates. In any case, it is a

positive finding that almost half of the participants continued training at least once-a-week, since even participating in RT only once-a-week leads to important physical improvements for older individuals compared to not participating at all.[26,41] However, another limitation of this study is that the continuance frequencies are based on self-reports and information about participants´ actual gym visits was not available. For example, Van Roie et al.[42] obtained information regarding gym visits from the fitness center and found that only 20% of participants continued RT during a 4-month follow-up and none of them met the recommended twice-a-week frequency. However, even though self-reports may both over- or underestimate the actual amount of physical activity,[43] even a single question could be a useful method to estimate physical activity.[44]

The present study provided some interesting findings regarding motivational and volitional characteristics and RT continuation. Firstly, contrary to previous research,[15,18] the level of the characteristics was not related to RT continuation. A possible reason for that could be that the participants of this study had relatively high values in these characteristics already at baseline (e.g. compared to a sample of younger physically inactive Finnish adults[28]). In addition, it is possible that participants may have had high motivation for exercise in general but they preferred physical activities other than RT. This may not have been observable in the present study because the measurements used were related to non-specific physical activity or exercise. Indeed, when exercise preferences were asked from participants at follow-up 2, over half of them mentioned some type of aerobic exercise and only 16% mentioned RT as their favorite type of exercise. Unfortunately, the information about frequency to participate in other physical activities during the follow-up period was not gathered in the present study.

Secondly, increases in exercise self-efficacy and intrinsic motivation related to training during the intervention were related to continuance of RT during follow-up. Individuals with high exercise self-efficacy have better strategies and are ready to put more effort on exercising and overcoming barriers. It is possible that during regular participation in RT for nine months, some participants realized that they could overcome the potential barriers and that contributed to continuing RT also after the intervention. This finding supports the results of previous studies in relation to self-efficacy change and exercise continuance.[18,45] Regarding intrinsic motivation, it is possible that simply those who enjoy RT continued training after the intervention. Thirdly, there were differences only between twice-a-week continuers and non-continuers, not between once-a-week continuers and non-continuers. Moreover, twice-a-week continuers had greater increases in intrinsic motivation also compared to once-a-week continuers. This is an important finding for future studies to investigate because RT twice-a-week is superior to once-a-week for strength gains.[46] According to the results of the presents study, it can be suggested that by improving motivational and volitional characteristics related to exercise it could be possible to also increase RT participation. It has been shown that RT programs with behavioral counselling are more effective for the adoption of RT and exercise self-efficacy than basic programs including only exercise.[47,48] Therefore, physical activity interventions should also aim to improve these characteristics in order to promote the continuance of behavior after the intervention.

When generalizing the results of this study, it should be taken into account that first, only 23% of the original random sample replied to the invitation letters. As mentioned above, it is possible that the study sample was already highly motivated to participate in exercise/RT. Secondly, the sample consisted of healthy older adults aged 65–75 who did not meet the physical activity guidelines for

either leisure time aerobic exercise or RT at baseline. Therefore, the results may not necessarily be generalized to different patient groups, all ages or more physically active individuals. It should be noted that the amount of leisure time aerobic exercise and RT background at baseline were measured with single questions, thus the information about specific exercise patterns before the intervention is not available. Thirdly, as a secondary analysis of a randomized controlled trial, this study may have been unpowered to detect differences in motivational and volitional characteristics with this sample size.

Perspectives

As resistance training is beneficial and recommended for older adults [1-4], but only a minority regularly participate (~10%) in it,[6] it is essential to identify ways to promote participation in resistance training activities. The present study showed that a resistance training intervention can improve exercise-related motivational and volitional characteristics and these improvements were related to continuing self-directed resistance training after the intervention. Therefore, if interventions can target and improve exercise motivation and self-efficacy, then it may be possible to increase participation rates in regular resistance training in healthy older populations.

Acknowledgements

This work was supported by a personal grant to Simon Walker from the Ministry of Education and Culture of Finland (OKM/56/626/2014). The authors declare that there is no conflict of interest.

References

1. Liu CJ, Latham NK. Progressive resistance strength training for improving physical function in older adults. *Cochrane Database Syst Rev*. 2009;3(3):CD002759.

2. Latham NK, Bennett DA, Stretton CM, Anderson CS. Systematic review of progressive resistance strength training in older adults. *J Gerontol A-Biol*. 2004;59(1):48-61.

3. Hunter GR, McCarthy JP, Bamman MM. Effects of resistance training on older adults. *Sports Med*. 2004;34(5):329-348.

4. Chodzko-Zajko WJ, Proctor DN, Fiatarone Singh MA, et al. American College of Sports Medicine position stand. Exercise and physical activity for older adults. *Med Sci Sport Exer*. 2009;41(7):1510.

5. UKK-instituutti. Terveysliikunnan suositukset: Viikoittainen liikuntapiirakka yli 65-vuotiaille [Recommendations for health-enhancing physical activity for older adults 65+: Weekly physical activity pie]. http://www.ukkinstituutti.fi/liikuntapiirakka/liikuntapiirakka-

_yli_65-vuotiaille. 2014. Accessed February 27, 2018.

6. Bennie JA, Pedisic Z, Suni JH, et al. Self-reported health-enhancing physical activity recommendation adherence among 64,380 Finnish adults. *Scand J Med Sci Sports*. 2017;27(12):1842-1853.

7. Standage M, Ryan RM. Self-determination theory and exercise motivation: Facilitating self-regulatory processes to support and maintain health and well-being. In: Roberts GC, Treasure DC, eds. Advances in motivation in sport and exercise. Champaign, IL: Human Kinetics.; 2012:233-270.

8. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol*. 2000;55(1):68-78.

9. Schwarzer R. Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Appl Psychol Int Rev*. 2008;57(1):1-29.

10. Sniehotta FF, Schwarzer R, Scholz U, Schüz B. Action planning and coping planning for long-term lifestyle change: Theory and assessment. *Eur J Soc Psychol*. 2005;35(4):565-576.

11. Sniehotta FF, Scholz U, Schwarzer R. Action plans and coping plans for physical exercise: A longitudinal intervention study in cardiac rehabilitation. *Brit J Health Psych*. 2006;11(1):23-37.

12. Schwarzer R, Renner B. Social-cognitive predictors of health behavior. *Health Psychol*. 2000;19(5):487-495.

13. Bandura A. Self-efficacy. In: Ramachaudran VS, ed. Encyclopedia of human behavior. New York, NY, US: Academic Press; 1994:71-81.

14. McAuley E, Blissmer B. Self-efficacy determinants and consequences of physical activity. *Exerc Sport Sci Rev*. 2000;28(2):85-88.

15. Teixeira PJ, Carraça EV, Markland D, Silva MN, Ryan RM. Exercise, physical activity, and self-determination theory: A systematic review. *Int J Behav Nutr Phy*. 2012;9(1):78-107.

16. Winett RA, Williams DM, Davy BM. Initiating and maintaining resistance training in older adults: A social cognitive theory-based approach. *Brit J Sport Med*. 2009;43(2):114-119.

17. Winett R, Davy B, Savla J, et al. Theory-based approach for maintaining resistance training in older adults with prediabetes: Adherence, barriers, self-regulation strategies, treatment fidelity, costs. *Behav Med Pract Policy Res*. 2015;5(2):149-159.

18. Neupert SD, Lachman ME, Whitbourne SB. Exercise self-efficacy and control beliefs predict exercise behavior after an exercise intervention for older adults. *J Aging Phys Act*. 2009;17(1):1-16.

19. Van Roie E, Bautmans I, Coudyzer W, Boen F, Delecluse C. Low- and high-resistance exercise: Long-term adherence and motivation among older adults. *Gerontology*. 2015;61(6):551-560.

20. Katula JA, Rejeski WJ, Marsh AP. Enhancing quality of life in older adults: A comparison of muscular strength and power training. *Health Qual Life Out*. 2008;6(1):45-52.

21. LeCheminant JD, Hinman T, Pratt KB, et al. Effect of resistance training on body composition, self-efficacy, depression, and activity in postpartum women. *Scand J Med Sci Spor*. 2014;24(2):414-421.

22. Milne H, Wallman K, Gordon S, Courneya K. Impact of a combined resistance and aerobic exercise program on motivational variables in breast cancer survivors: A randomized controlled trial. *Ann Behav Med*. 2008;36(2):158-166.

23. Heiestad H, Rustaden AM, Bø K, Haakstad LAH. Effect of regular resistance training on motivation, self-perceived health, and quality of life in previously inactive overweight women: A randomized, controlled trial. *Biomed Res Int*. 2016;2016:3815976.

24. Walker S, Haff GG, Häkkinen K, Newton RU. Moderate-load muscular endurance strength training did not improve peak power or functional capacity in older men and women. *Front Physiol*. 2017;8:743.

25. Fernandez-Lezaun E, Schumann M, Makinen T, Kyrolainen H, Walker S. Effects of resistance training frequency on cardiorespiratory fitness in older men and women during intervention and follow-up. *Exp Gerontol*. 2017;95:44-53.

26. Turpela M, Hakkinen K, Haff GG, Walker S. Effects of different strength training frequencies on maximum strength, body composition and functional capacity in healthy older individuals. *Exp Gerontol*. 2017;98:13-21.

27. Schwarzer R, Renner B. Health-specific self-efficacy scales. https://userpage.fu-berlin.de/health/healself.pdf 2009. Accessed February 27, 2018.

28. Kangasniemi AM, Lappalainen R, Kankaanpää A, Tolvanen A, Tammelin T. Towards a physically more active lifestyle based on one's own values: The results of a randomized controlled trial among physically inactive adults. *BMC Public Health*. 2015;15(1):260-273.

29. Hankonen N, Absetz P, Ghisletta P, Renner B, Uutela A. Gender differences in social cognitive determinants of exercise adoption. *Psychol Health*. 2010;25(1):55-69.

30. Deci EL, Ryan RM. "Exercise self-regulation questionnaires". Self-determination theory: An approach to human motivation and personality - the self-regulation questionnaires. http://selfdeterminationtheory.org/self-regulation-questionnaires/. 2004. Accessed February 27, 2018.

31. Silva MN, Markland D, Vieira PN, et al. Helping overweight women become more active: Need support and motivational regulations for different forms of physical activity. *Psychol Sport Exerc*. 2010;11(6):591-601.

32. Levesque CS, Williams GC, Elliot D, Pickering MA, Bodenhamer B, Finley PJ. Validating the theoretical structure of the treatment self-regulation questionnaire (TSRQ) across three different health behaviors. *Health Educ Res*. 2007;22(5):691-702.

33. Nurmi J, Hagger MS, Haukkala A, Araújo-Soares V, Hankonen N. Relations between autonomous motivation and leisure-time physical activity participation: The mediating role of self-regulation techniques. *J Sport Exercise Psy*. 2016;38(2):128-137.

34. Tavakol M, Dennick R. Making sense of Cronbach's alpha. *Int J Med Educ*. 2011;2:53-55.

35. Waller B, Munukka M, Multanen J, et al. Effects of a progressive aquatic resistance exercise program on the biochemical composition and morphology of cartilage in women with mild knee osteoarthritis: Protocol for a randomised controlled trial. *Bmc Musculoskel Dis*. 2013;14(1):82.

36. Cohen J. A power primer. *Psychol Bull*. 1992;112(1):155-159.

37. Rhodes RE, Lubans DR, Karunamuni N, Kennedy S, Plotnikoff R. Factors associated with participation in resistance training: A systematic review. *Br J Sports Med*. 2017;51(20):1466-1472.

38. McAuley E, Jerome GJ, Elavsky S, Marquez DX, Ramsey SN. Predicting long-term maintenance of physical activity in older adults. *Prev Med*. 2003;37(2):110-118.

39. Geirsdottir OG, Arnarson A, Ramel A, Briem K, Jonsson PV, Thorsdottir I. Muscular strength and physical function in elderly adults 6–18 months after a 12-week resistance exercise program. *Scand J Public Healt*. 2015;43(1):76-82.

40. Inaba Y, Obuchi S, Arai T, Satake K, Takahira N. The long-term effects of progressive resistance training on health-related quality in older adults. *J Physiol Anthropol*. 2008;27(2):57-61.

41. Taaffe DR, Duret C, Wheeler S, Marcus R. Once-weekly resistance exercise improves muscle strength and neuromuscular performance in older adults. *J Am Geriatr Soc*. 1999;47(10):1208-1214.

42. Van Roie E, Bautmans I, Coudyzer W, Boen F, Delecluse C. Low- and high-resistance exercise: Long-term adherence and motivation among older adults. *Gerontology*. 2015;61(6):551-560.

43. Prince SA, Adamo KB, Hamel ME, Hardt J, Connor Gorber S, Tremblay M. A comparison of direct versus self-report measures for assessing physical activity in adults: A systematic review. *Int J Behav Nutr Phy*. 2008;5(1):56.

44. Portegijs E, Sipilä S, Viljanen A, Rantakokko M, Rantanen T. Validity of a single question to assess habitual physical activity of community-dwelling older people. *Scand J Med Sci Spor*. 2017;27(11):1423-1430.

45. Baruth M, Wilcox S. Predictors of physical activity 6 months postintervention in the active for life initiative. *J Phys Act Health*. 2014;11(2):256-265.

46. Ratamess NA, Housh TJ, Alvar BA, et al. Progression models in resistance training for healthy adults. *Med Sci Sport Exer*. 2009;41(3):687-708.

47. Teychenne M, Ball K, Salmon J, et al. Adoption and maintenance of gym-based strength training in the community setting in adults with excess weight or type 2 diabetes: A randomized controlled trial. *Int J Behav Nutr Phy*. 2015;12:105-113.

48. Katula JA, Sipe M, Rejeski WJ, Focht BC. Strength training in older adults: An empowering intervention. *Med Sci Sport Exer*. 2006;38(1):106-111.

Table 1. Participants´ demographic, motivational and volitional characteristics at baseline. Mean values with standard deviations in parentheses or frequencies presented.

	CG (n=23)	RT 1 (n=26)	RT 2 (n=27)	RT 3 (n=28)	p[a]
Gender: female %	47.8	53.8	59.6	57.1	.864
Education %					.091
Basic education	30.4	32.0	15.4	53.6	
Upper secondary education	21.7	32.0	42.3	25.0	
Tertiary education	47.8	36.0	42.3	21.4	
Age, y	68.3 (2.3)	68.9 (2.7)	67.7 (2.8)	69.0 (3.3)	.282
BMI, kg/m^2	26.4 (2.6)	27.3 (3.3)	28.6 (4.4)	29.0 (4.1)	.070
Aerobic exercise, min/week	110 (63)	113 (64)	111 (56)	85 (58)	.143
Exercise self-efficacy [10-40]	31.7 (3.2)	32.0 (4.5)	31.4 (5.5)	31.8 (4.0)	.967
Action planning [4-16]	11.4 (2.2)	11.6 (2.8)	10.5 (3.0)	10.6 (2.7)	.374
Coping planning [4-16]	10.8 (2.8)	11.0 (2.7)	10.3 (2.7)	8.9 (2.7)	.024 (1>3)
PA: External [1-7]	2.2 (1.0)	2.8 (1.8)	2.0 (1.0)	2.4 (1.3)	.136
PA: Introjected [1-7]	4.0 (1.2)	4.5 (1.4)	3.7 (1.1)	4.0 (1.4)	.184
PA: Identified. [1-7]	6.0 (0.9)	6.2 (0.8)	6.3 (0.7)	6.0 (0.9)	.661
PA: Intrinsic [1-7]	5.6 (1.2)	5.8 (1.1)	5.7 (1.0)	5.8 (1.1)	.904
TR: External [1-7]	3.4 (1.5)	4.0 (1.8)	3.7 (1.9)	3.4 (1.7)	.525
TR: Introjected. [1-7]	4.1 (0.8)	4.5 (1.3)	4.3 (1.1)	4.3 (1.0)	.757
TR: Identified. [1-7]	5.9 (1.1)	6.1 (0.9)	6.2 (0.8)	5.9 (1.1)	.684
TR: Intrinsic [1-7]	5.4 (1.4)	5.7 (1.2)	5.6 (1.0)	5.3 (1.3)	.757

[a]Differences between groups tested by one-way ANOVA for continuous variables and Chi-Square test for categorical variables. CG=control group, RT1-3=resistance training 1, 2 or 3 times/week groups, PA = motivational regulation related to physical activity, TR = motivational regulation related to training.

Table 2. Effect of the intervention on motivational and volitional characteristics, analyzed by generalized estimated equations (GEE). p-values presented.

	GEE model months 1-3[a]			GEE model months 3-9[b]			GEE model months 0-9[c]		
	Group	Time	Group× time	Group	Time	Group× time	Group	Time	Group× time
Self-efficacy	.246	.325	**<.001**	.234	**.004**	.136	.934	.094	.265
Action plan.	.986	**.005**	**.006**	.253	.857	.678	.775	**<.001**	**<.001**[d]
Coping plan.	.983	.275	**.010**	.167	**.041**	.397	**.045**	**.001**	**.012**[e]
PA:External	.472	.298	.283	.721	.995	.174	.356	.133	.136
PA:Introjected	.211	.778	.296	.753	.653	.203	.691	.348	**.025**[f]
PA:Identified	.680	.175	.133	.823	.973	.381	.593	.253	.087
PA:Intrinsic	.868	.638	.255	.885	.435	.100	.960	.832	**.030**[g]
TR:External.	.747	**.002**	.125	.829	.608	.139	.647	**.002**	.380
TR:Introjected	.688	.146	.379	.816	.782	.069	.928	**<.001**	.998
TR:Identified	.991	.303	.064	.829	.852	.464	.714	.654	.281
TR:Intrinsic	.873	.998	**.007**	.541	.794	.215	.891	.277	**<.001**[h]

Models adjusted by mean aerobic exercise (min/week) from [a]months 1-3, [b]months 3-9 and [c]months 1-9. PA = motivational regulation related to physical activity, TR = motivational regulation related to training. Significant differences between [d]CG vs. RT1 p=.019, CG vs. RT2 p<.001, CG vs. RT3 p<.001; [e]CG vs. RT2 p=.010, CG vs. RT3 p=.001; [f]CG vs. RT2 p=.026; RT1 vs. RT2 p=.004; [g]CG vs. RT2 p=.013, CG vs. RT3 p=.009; [h]CG vs. RT2 p=.008, CG vs. RT3 p<.001, RT1 vs. RT2 p=.047, RT1 vs. RT3 p=.003.

Table 3. Means and standard deviations (SD) in motivational and volitional characteristics at baseline, month-3 and month-9, and effect sizes (Cohen´s *d*) for mean changes between the groups.

	Baseline Mean(SD)	Month-3 Mean(SD)	Month-9 Mean(SD)	ΔEffect size (95%CI) 1-3	ΔEffect size (95%CI) 3-9	ΔEffect size (95%CI) 0-9
Self-efficacy						
CG	31.7 (3.2)	30.5 (2.7)[a]	30.3 (3.0)			
RT1-3	31.7 (4.6)	32.6 (4.2)[a]		.70 (.21-1.20)		
RT1	32.0 (4.5)	32.7 (3.8)	31.2 (4.3)[b]		-.79 (-1.42- -.17)	.19 (-.41-.78)
RT2	31.4 (5.5)	32.2 (4.6)	32.1 (4.6)		-.22 (-.81-.38)	.51 (-.10-1.10)
RT3	31.8 (4.0)	32.7 (4.1)	31.3 (3.9)[b]		-.66 (-1.27--.06)	.21 (-.37-.78)
Action planning						
CG	11.4 (2.2)	11.6 (1.6)	11.0 (2.7)			
RT1-3	10.9 (2.8)	12.5 (2.4)[a]		.52 (.03–1.00)		
RT1	11.6 (2.8)	12.2 (2.8)	12.5 (2.0)		.09 (-.52–.69)	.61 (-.01–1.21)
RT2	10.5 (3.0)	12.5 (2.5)	12.7 (2.1)[c]		.08 (-.52–.67)	1.17 (.52–1.78)
RT3	10.6 (2.9)	12.7 (2.7)	12.4 (1.8)[c]		-.10 (-.69–.49)	1.05 (.43–1.65)
Coping planning						
CG	10.8 (2.8)	10.5 (2.1)	10.3 (12.3)			
RT1-3	10.0 (2.8)	11.4 (2.5)[a]		.52 (.03–1.00)		
RT1	11.0 (2.7)	11.2 (2.8)	11.9 (1.9)		.06 (-.54–.66)	.43 (-.18–1.02)
RT2	10.3 (2.7)	11.6 (2.2)	11.7 (2.2)[c]		-.26 (-.85–.34)	.75 (.13–1.35)
RT3	8.9 (2.7)	11.2 (2.6)	11.1 (1.8)[c]		-.27 (-.86–.33)	.94 (.32–1.52)
PA: External						
CG	2.1 (1.0)	1.9 (1.2)	1.8 (0.7)			
RT1-3	2.4 (1.4)	2.4 (1.3)		.25 (-.23–.74)		
RT1	2.8 (1.8)	2.4 (1.7)	2.6 (1.6)		.33(-.28–.93)	.23 (-.37–.86)
RT2	2.0 (0.9)	2.2 (1.0)	2.2 (1.0)		-.03 (-.62–.57)	.55 (-.06–1.13)
RT3	2.4 (1.3)	2.6 (1.2)	2.2 (1.0)		-.34 (-.93–.26)	.05 (-.52–.63)
PA: Introjected						
CG	4.0 (1.2)	4.2 (1.3)	4.0 (1.0)			
RT1-3	2.1 (1.3)	4.3 (1.1)		-.29 (-.77–.20)		
RT1	4.5 (1.4)	4.1 (1.3)	4.0 (1.3)[c]		.18 (-.42–.78)	-.33 (-.92–.27)
RT2	3.8 (1.1)	3.8 (1.2)	4.1 (1.2)		.61 (-.01–1.20)	.56 (-.05–1.15)[d]

RT3	4.0 (1.4)	3.8 (1.4)	4.0 (1.0)		.26 (-.34–.84)	.13 (-.45–.70)
PA: Identified						
CG	6.1 (1.0)	5.9 (1.1)	5.9 (1.0)			
RT1-3	6.2 (0.8)	6.2 (0.9)		.51 (.02–1.00)		
RT1	6.2 (0.8)	6.3 (0.8)	6.1 (0.7)		-.21 (-.81–.40)	.29 (-.31–.88)
RT2	6.3 (0.7)	6.2 (1.0)	6.3 (0.7)		.22 (-.38–.80)	.51 (-.09–1.10)
RT3	6.0 (0.9)	6.1 (0.9)	6.1 (0.8)		.01 (-.58–.60)	.59 (.00–1.17)
PA: Intrinsic						
CG	5.6 (1.2)	5.7 (1.2)	5.6 (0.9)			
RT1-3	5.8 (1.1)	5.9 (1.1)		.20 (-.29–.68)		
RT1	5.8 (1.1)	5.7 (1.2)	5.7 (0.9)		-.18 (-.78–.42)	.20 (-.40–.79)
RT2	5.7 (1.0)	5.8 (1.2)	6.0 (0.9)		.52 (-.09–1.11)	.65 (.04–1.24)
RT3	5.8 (1.1)	5.8 (1.1)	6.0 (0.9)		.41 (-.20–1.00)	.67 (.07–1.25)
TR: External						
CG	3.3 (1.5)	3.1 (1.5)	2.9 (1.2)			
RT1-3	3.7 (1.8)	3.6 (1.6)		.08 (-.40–.56)		
RT1	4.0 (1.8)	3.5 (1.7)	3.6 (1.6)		.35 (-.27–.94)	.07 (-.52–.66)
RT2	3.7 (1.9)	3.4 (1.6)	3.6 (1.5)		.28 (-.31–.87)	.21 (-.38–.80)
RT3	3.4 (1.7)	3.5 (1.5)	3.2 (1.5)		-.23 (-.82–.37)	.09 (-.49–.66)
TR: Introjected						
CG	4.1 (0.8)	4.1 (1.1)	3.9 (0.8)[c]			
RT1-3	4.3 (1.1)	4.1 (1.2)[a]		-.22 (-.70–.27)		
RT1	4.5 (1.3)	4.2 (1.3)	4.1 (1.1)		.07 (-.53–.68)	.36 (-.25–.95)
RT2	4.3 (1.1)	3.8 (1.1)	4.1 (0.9)		.53 (-.08–1.12)	-.03 (-.61–.56)
RT3	4.3 (1.0)	4.3 (1.1)	4.0 (1.0)[c]		-.38 (-.97–.23)	-.07 (-.65–.50)
TR: Identified						
CG	5.9 (1.1)	5.7 (1.1)[a]	5.7 (1.1)			
RT1-3	6.1 (0.9)	6.1 (1.0)		.65 (.15–1.13)		
RT1	6.1 (0.8)	6.2 (0.9)	6.1 (0.8)		-.22 (-.82–.39)	.36 (-.25–.95)
RT2	6.2 (0.8)	6.0 (1.1)	6.2 (0.8)		.15 (-.45–.74)	.51 (-.10–1.10)
RT3	5.9 (1.1)	6.1 (0.9)	6.0 (1.0)		-.27 (-.86–.32)	.45 (-.14–1.03)
TR: Intrinsic						
CG	5.4 (1.4)	5.3 (1.3)	5.3 (1.1)			

RT1-3	5.5 (1.2)	5.8 (1.3)[a]		.64 (.14–1.13)		
RT1	5.7 (1.2)	5.8 (1.2)	5.4 (1.1)		-.51 (-1.11–.11)	.09 (-.50–.68)
RT2	5.6 (1.0)	5.7 (1.4)	5.9 (1.0)		.27 (-.33–.86)	.75 (.13–1.35)[e]
RT3	5.3 (1.3)	5.9 (1.1)	5.9 (1.2)[c]		-.03 (-.62–.57)	1.07 (.44–1.66)[f]

PA = motivational regulation related to physical activity, TR = motivational regulation related to training. Significant (p<.05) difference within group between [a]baseline and month-3, [b]month-3 and month-9, [c]baseline and month-9. [d]Effect size compared to RT1 0.84 (CI 0.25–1.42). [e]Effect size compared to RT1 0.57 (CI 0.00–1.15). [f]Effect size compared to RT1 0.84 (CI 0.31–1.37).

Table 4. The level of motivational and volitional characteristics post-intervention and changes during the intervention for non-continuers, once-a-week continuers and twice-a-week continuers.

	Non-continuers (n=42)	Once-a-week continuers (n=17)	Twice-a-week continuers (n=19)	
	n (%)	n (%)	n (%)	
Intervention group				5.05(4), 282[a]
RT1	16 (64%)	6 (24%)	3 (12%)	
RT2	13 (50%)	7 (27%)	6 (23%)	
RT3	13 (48%)	4 (15%)	10 (37%)	
	mean (SD)	mean (SD)	mean (SD)	F(df), p[b]
The level at post-intervention (9 months)				
Self-efficacy	31.0 (4.7)	32.0 (3.6)	32.1 (3.7)	.59(2), .556
Action planning	12.3 (1.9)	12.5 (2.0)	13.1 (2.1)	.98(2), .380
Coping planning	11.4 (2.3)	12.2 (1.1)	11.5 (1.9)	1.22(2), .301
PA: External	2.5 (1.3)	2.0 (1.1)	2.1 (1.2)	1.21(2), .305
PA: Introjected	4.0 (1.2)	4.0 (1.3)	4.1 (1.4)	.04(2), .959
PA: Identified	6.1 (0.8)	6.2 (0.6)	6.3 (0.8)	.16(2), .853
PA: Intrinsic	5.8 (1.0)	6.0 (0.9)	6.1 (0.9)	.78(2), .461
TR: External	3.4 (1.5)	3.3 (1.4)	3.5 (1.7)	.53(2), .590
TR: Introjected	4.1 (1.0)	3.9 (1.0)	4.0 (1.0)	.16(2), .849
TR: Identified	6.1 (0.9)	6.0 (0.8)	6.3 (1.0)	.16(2), .856

TR: Intrinsic	5.6 (1.2)	5.8 (0.9)	6.0 (1.2)	2.20(2), .118
Change during the intervention (from 0 to 9 months)				
Self-efficacy	-1.1 (3.3)	0.1 (3.2)	1.5 (3.4)	4.07(2), **.021**[c]
Action planning	1.6 (2.8)	1.7 (2.6)	1.7 (2.5)	.04(2), .961
Coping planning	1.5 (3.1)	1.9 (1.7)	1.3 (2.1)	.22(2), .803
PA: External	-0.1 (1.0)	-0.0 (1.0)	0.0 (0.5)	.08(2), .924
PA: Introjected	-0.1 (1.1)	-0.1 (1.1)	0.1 (1.0)	.71(2), .754
PA: Identified	0.0 (0.8)	-0.1 (0.6)	0.2 (0.7)	2.25(2), .494
PA: Intrinsic	0.1 (0.9)	-0.1 (0.9)	0.5 (0.6)	1.55(2), .112
TR: External	-0.4 (1.4)	-0.3 (1.2)	0.2 (1.0)	.78(2), 218
TR: Introjected	-0.3 (0.8)	-0.4 (0.8)	-0.1 (0.8)	.78(2), .464
TR: Identified	-0.0 (0.8)	-0.0 (0.9)	0.3 (0.6)	1.18(2), .313
TR: Intrinsic	0.1 (1.0)	0.2 (1.0)	0.9 (0.6)	6.94(24), **.002**[d]

Between-group differences analyzed by [a]Chi-square test or [b]one-way ANOVA. Bonferroni post-hoc tests:[c] difference between non-continuers vs. twice-a-week continuers, [d] difference between non-continuers vs. twice-a-week continuers and once-a-week continuers vs. twice-a-week continuers. PA = motivational regulation related to physical activity, TR = motivational regulation related to training.

Figure legends

Figure 1. Flowchart of the study.

Figure 2. Key findings: relative changes (± standard error estimation) in motivational characteristics between baseline and month-3 (Fig. A), between month-3 and month-9 (Fig. B) and between baseline and month-9 (Fig. C). TR= Training, PA=Physical Activity.

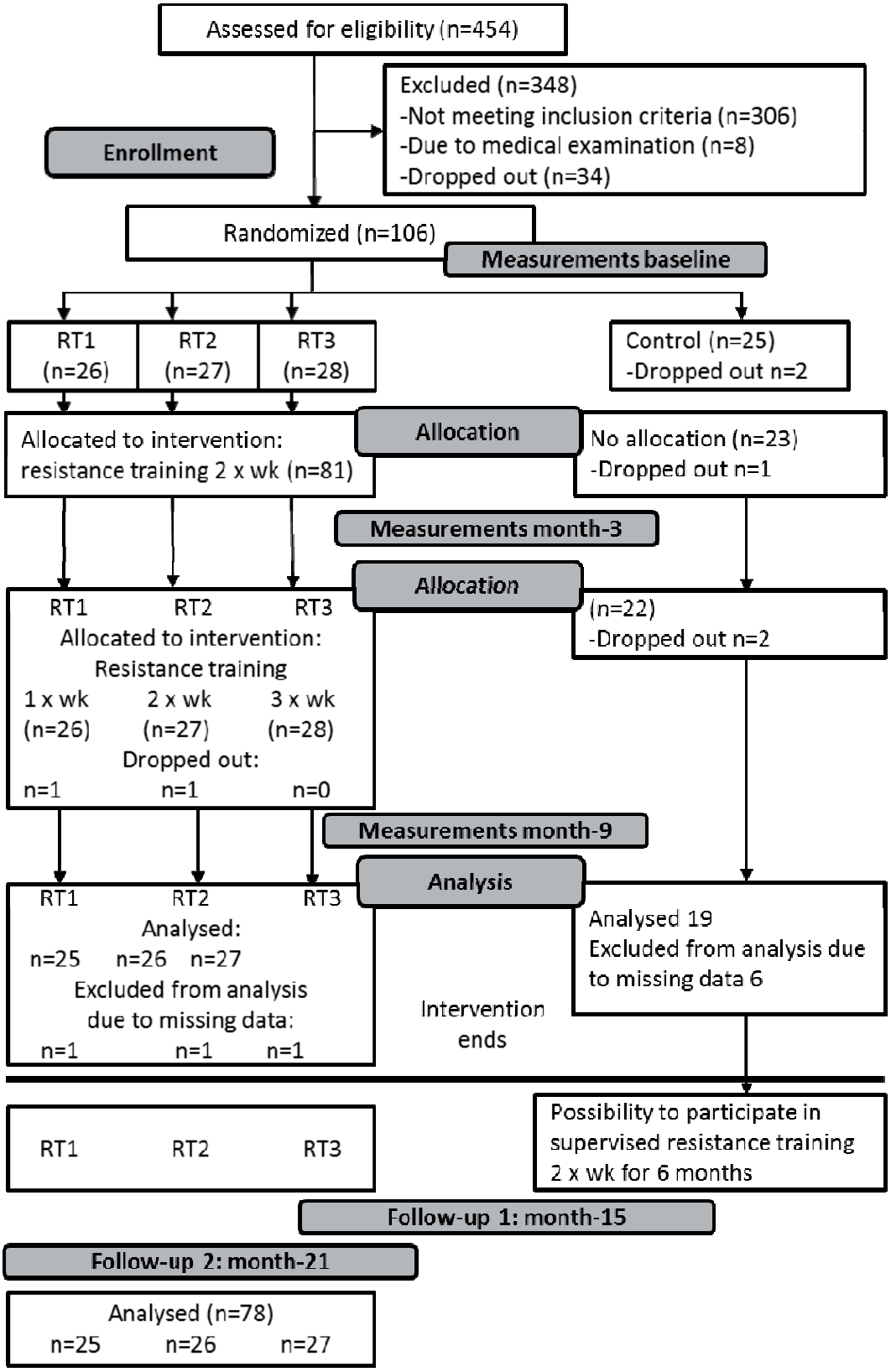

Figure 1.