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Life Satisfaction and the Oldest-Old

Results from the population study Good Aging in Skåne

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ABSTRACT

The overall aim of this thesis was to study life satisfaction (LS) and factors associated to LS in the group aged 78 and above. As an aid in interpreting the findings, Baltes' and Baltes' theory of selective optimisation with compensation (SOC) was used. All four studies included the same studypopulation who were followed for three years in the study Good Aging in Skåne, a national, randomized, population-based study of the elderly. Neugartens' life satisfaction index A (LSI-A) was the outcome variable in all four studies.

In study I the aim was to examine what factors affect LS in the oldest-old in a multi disciplinal perspective. Health-related as well as psychological and socio-economical factors were included. In a logistic multiple regression model the number of symptoms, marital status, health locus of control (HLoC) internal and powerful others, depressive mood and age could predict LS three years later. Independence in functional ability was related to unchanged LS, stratified for age and gender during the 3-year follow-up. The clinical implementations were that recognizing and treating factors that affect LS and are reachable for intervention in this age-group should be highlighted in clinical practice. Relieving symptoms and paying attention to personality factors that modify LS seem to be key-factors in the care of elderly.

Study II set out to describe the prevalence and experienced severity of symptoms and its' relation to LS in the oldest-old. Scores on the LSI-A were related to scores on a modified version of the Göteborg QoL instrument, covering 32 common symptoms.
The prevalence of symptoms was high: musculosceletal symptoms like pain were reported by 74%; 80% had depressive symptoms and 68 % general fatigue. Less than six percent of men and women reported no metabolic symptoms or symptoms related to the head. In a linear multiple regression model four groups of symptoms could predict LS three years later: depressive-, tensive-, GI-symptoms and musculoskeletal symptoms.
The clinical implication of this study is that careful attention should be paid to the elderly patients' description of his/her symptoms in the above areas since this could have the potential to increase the patients' LS.

In study III, we wanted to describe the change in functional ability (FA) in the oldest-old during three years and examine its relation to LS. FA was measured according to Hulter Åsbergs' ADL-scale. The greatest decline in ADL was seen in the eldest group (87-93 years) in which 51% reported decline during the three years. The group that reported decline in I-ADL had a mean LSI-value of 23.0 compared to 26.4 in the group that was unchanged. A decline in ADL had a stronger negative effect on LS in the younger group. In a linear multiple regression model impairment of FA, depressive mood and the number of symptoms predicted lower LS after controlling for age. Being married and scoring higher on power and internal HLoC was associated with higher LS. The findings point to the importance of rehabilitation and training of this group not only for the purpose of physical restoration but also due to its potential to increase the LS of this population. If further research confirms that the association is not as

strong for the very oldest, then perhaps this needs consideration when planning rehabilitation and treatment for this group.

Study IV set out to explore if cognitive abilities could predict LS three years later in the oldest-old. Correlations between 13 cognitive tests related to six different cognitive domains, and Neugartens' LSI-A three years later were calculated for the whole sample as well as stratified for factors known to affect cognitive abilities; age, depressive mood, dementia, stroke, sex, education and functional capacity.
A linear multiple regression model was constructed for each cognitive domain separately with LSI-A at re-examination as dependent variable. The models were adjusted stepwise for age, sex, education, functional ability and depressive mood. Processing speed (B=0.118, p=0.020) and spatial ability (B=0.453, p=0.014) remained significantly associated to LS after adjustment. Possible clinical implications were discussed.

ORIGINAL PAPERS

This thesis is based on the following papers referred to in the text by their Roman numerals:

I Enkvist Å, Ekström H, Elmståhl S. What factors affect life satisfaction (LS) among the oldest-old? Arch Gerontol Geriatr; 2012 Jan; 54(1):140-145

II Enkvist Å, Ekström H, Elmståhl S. Life satisfaction (LS) and symptoms among the oldest-old: Results from the longitudinal population study called Good Aging in Skåne (GÅS). Arch Gerontol Geriatr; 2012 Jan; 54(1):146-50

III Enkvist Å, Ekström H, Elmståhl S. Associations between functional ability and life satisfaction in the oldest-old. Results from the longitudinal population study Good Aging in Skåne. Clinical Interventions in Aging, 2012:7:313–320

IV Enkvist Å, Ekström H, Elmståhl S. Associations between cognitive abilities and life satisfaction in the oldest-old. Results from the longitudinal population study Good Aging in Skåne. Clinical Interventions in Aging, 2013:8:845-853

CONTENTS

Thesis at a glance 10
Abbreviations 11
Introduction 13
Background 15
The concepts 18
Factors related to life satisfaction 22
Aims 27
Methods 29
Data collection 31
Data analysis 37
Ethical considerations 38
Results 39
Study I 41
Study II 45
Study III 48
Study IV 53
Discussion 61
Methodological discussion 67
Discussion of results 67
Conclusions 77
Further research 78
Summary in Swedish 79
Aknowledgements 86
References 87
Appendix A+B 98
Paper I-IV

THESIS AT A GLANCE

Paper	Question	Answer	Methods
I	What factors predict life satisfaction in the oldest-old?	We found that the number of symptoms, marital status, aspects of health locus of control (internal and powerful others), depressive mood and age could predict LS three years later.	681 individuals aged 78-98 years were examined with a three year interval by physician, nurse and psychologist. They also answered multiple questionnaires concerning life satisfaction, social network, economy, health locus of control and symptoms.
II	What do the associations between LS and symptoms look like in the oldest-old?	There is a clear association between LS and burden of symptoms, especially symptoms of a depressive and tensive kind, as well as symptoms from the gastrointestinal and musculoskeletal tract.	Scores on Tibblins' symptom scale at baseline were related to Neugartens' LSI-A index three years later in the same study population as in study I.
III	How does functional ability change in the oldest-old during three years? Are there associations between functional ability and the oldest-old?	30% of the study population reported impaired ADL-function three years later. Decline in ADL-capacity was associated to lower LS after adjustment for confounders.	Scores on Hulter Åsbergs' ADL-scale were compared between baseline and re-examination in the same study population as in study I and II. ADL-scores were also related to Neugartens' LSI-A three years later.
IV	Can cognitive abilities predict LS three years later in the oldest-old?	Yes, there is an association between cognitive abilities and LS, especially processing speed and spatial ability.	Scores on 13 cognitive tests organized into six cognitive domains were related to Neugartens' LSI-A three years later in the same studypopulation as in study I, II and III.

ABBREVIATIONS

ADL	Activities of Daily Living
CPRS	Comprehensive Psychiatric Rating Scale
FA	Functional Ability
GÅS	Good Aging in Skåne (the project)
Gc	Crystallized intelligence
Gf	Fluid intelligence
GQoL	Gothenburg Quality of Life instrument
ICD	International classification of diseases
i-ADL	Instrumental Activities of Daily Life
HLoC	Health Locus of Control
LoC	Locus of Control
LS	Life Satisfaction
LSI-A	Life Satisfaction Index-A
MMSE	Mini Mental State Examination
p-ADL	Personal Activities of Daily Life
p-value	The probability that statistically obtained results are due to chance
QoL	Quality of Life
R	Respondent
SA	Successful Aging
SD	Standard Deviation
SNAC	Swedish National Study on Aging and Care
SOC	Selective optimisation with compensation
SWB	Subjective well-being
SRB1	Synonyme, reasoning and blocktest
TMT	Trailmaking test
Validity	The degree to which an instrument measures what it was constructed to measure
WHO	World Health Organisation

INTRODUCTION

During the last decades, gerontology has partly shifted focus from outcomes such as disease and disability to life satisfaction (LS), quality of life (QoL), successful aging and other related terms. Research in this area in the age-group called "the oldest-old" is a growing field. More research of this kind is motivated for different reasons.

First, this segment of the population is exposed to more threats to LS than can be said about any other group in society. Losses of loved ones as well as losses of bodily strength and functional ability are just some of the challenges to LS in this age. German psychologist Paul Baltes (1997) concluded that "old age is still young", meaning that the increase in life expectancy has occurred during a rather short period of time, and humanity has not yet had the time and opportunity to tackle the challenges presented by this increase. Medical, social and technical advances have been able to offset the inherent weaknesses of old age for the young-olds. These successes are not as evident for the oldest-old (Baltes, 2003). A major challenge in the years to come for researchers in various areas – medicine and technology to name a few – includes finding ways to optimize health, independency and high quality of life in this age-group.

Secondly, the oldest-old is the most rapidly growing part of the population in the Western world. The need for knowledge about LS and related concepts is of obvious importance in this emerging large part of the population. The subject needs to be approached from medical as well as social and psychological perspectives.

Thirdly, previous research has yielded inconsistent results. Some studies have indicated that LS is stable throughout the life span (Diener et al, 1999) while others have shown that LS decreases in the oldest-old (Berg et al, 2009). The findings of what factors yield sustained or diminished LS in old ages have also been ambiguous; health factors, social network, personality factors and cognitive aspects are some of the factors that have been dealt with in previous research.

Taken together, the need for studies with access to longitudinal data covering a broad range of factors known to affect LS; medical, social, psychological and environmental, is great.

BACKGROUND

The number of individuals in Sweden aged 80 and above is estimated to double by year 2030. Old age is the strongest risk factor for severe disease, loss of functional capacity and death; thereby also for consumption of healthcare (Rundgren and Dehlin, 2004). Medical conditions that would have been fatal a few decades ago are now survived leading to increasing numbers of people living with one or more chronical diseases. This constitutes a great challenge for the healthcare system in the years to come.

Prevalence of common diseases such as hypertension, diabetes, cardiovascular diseases, dementia and osteoarthritis are well known to increase with age. In a recent review article, Marengoni et al (2011) found the prevalence rate of *multimorbidity* in older persons to be between 55 and 98%; with multimorbidity defined as co-occurrence of multiple diseases in the same individual. Impaired QoL and functional ability were found to be two major consequences of the condition. Another nearby concept is *frailty* that has been defined as "a state of increased vulnerability to stressors that results from decreased physiological reserves, and even dysregulation, of multiple physiological systems", (Fried et al, 2004). Frailty has also been shown to affect QoL negatively (Bilotta et al, 2010).

Lyyra et al (2006) found that the level of satisfaction with present life is a strong predictor of mortality in the oldest-old after multiple adjustments.

In this setting, reflection on the concepts "disease" and "health" have been actualized in gerontology and geriatrics during the last decades. The traditional classification of "healthy" and "diseased" using medical diagnoses has been broadened, and the health-conception is now more often understood to encompass terms such as quality of life and other nearby concepts describing "the good life". By contrast, a widening of the concept "diseased" is also necessary, moving from only including medical diagnoses to including measures of frailty, impaired functional ability or a high burden of symptoms. Al-Windi et al (2005 and 2002) found LS to be the strongest predictor of perceived health. Individuals reporting lower perceived health and multiple symptoms separately, utilize the health care system to a higher degree than others after adjustment for other factors known to affect health care utilization.

Existing studies on LS throughout the life-span have shown somewhat inconsistent findings and have for the most part not focused on the oldest-old. Costa et al conducted a large, longitudinal study to examine whether environment or disposition carries the main influence on well-being (Costa el at, 1987). They found that personality factors explain the main part of variance in well-being and since personality traits are rather constant throughout life, they argue that well-being has a weak association with age. The oldest participators in this study were 85.

Mroczek and Spiro (2005) followed almost 2000 men for 22 years to study how LS changes with increasing age. They found LS to peak at age 65 and then decline, with large inter-individual differences, thus suggesting an inverted u-shape pattern. This study adds important knowledge but is restricted to men only, plus the fact that

99% of the studypopulation was under age 85. Another interesting finding in Mrozceks' study was that proximity to death was associated with declining LS, even when no signs of physical disease were noticed. This gives rise to the interesting possibility that constructs such as LS could be more sensitive indicators of serious medical conditions than traditional physiological variables such as blood tests or blood pressure. This is in agreement with the concept of terminal decline. Blanchflower and Oswald (2008) in their large international study, found opposite results with a u-shaped pattern with well-being reaching its' lowest point at age 55-60 and then increasing.
Studies specifically focusing on the oldest-old though (Berg et al, 2009; Baltes and Smith, 2003) tend to report difficulties in maintaining LS in advanced age.

Baltes and Smith (psychology and aging, 1997) conducted a study in which they created an index of desirability in psychological profile. The aim of the study was to see whether the risk of being in a group with a less desirable psychological profile was higher with higher age and female sex. A person with less loneliness, higher results on measures of fluid and crystallized intelligence (Gf and Gc), more extraversion and more internal LoC was considered to have a positive profile. The relative risk of having a less desirable profile was 2.5 times higher for the oldest-old (here defined as 85 and above) compared to the younger group (70-84).

Figure 1 shows data from the Berlin Aging Study. (Smith and Baltes, 2003). Participants were distributed into four different age groups classified as "good", "average", "poor" and "very poor" after joint-consideration of 23 physical, mental, psychosocial, social and economical indicators. As illustrated in the figure, the oldest-old are much more frequent in the undesirable groups than the younger old.

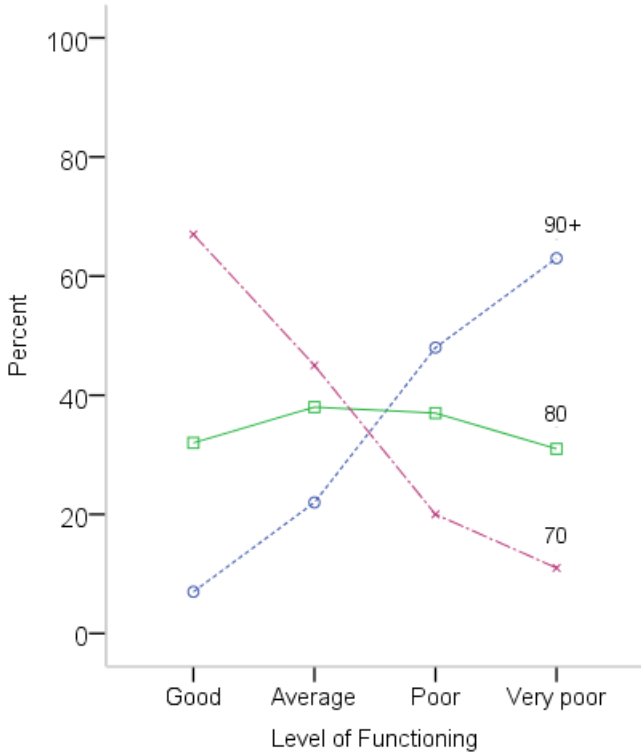

Figure 1. *Participants from Berlin Aging Study stratified by age and divided into four groups depending on functional status after joint consideration of 23 indicators of physical, social, economical and psychological factors. (Modified from Baltes and Smith, 2003)*

Wellbeing has also been compared across nations and related to freedom of choice (Inglehart et al, 2008) and economic status (Blanchflower and Oswald, 2008). In countries with higher mean incomes, people claim to have higher SWB. There are two exceptions to this association with Latin American countries scoring higher and the ex-communist countries scoring lower on SWB than economic conditions would predict. As for the elderly populations very few comparisons have been made.

Blanchflower and Oswald (2008) also found that comparing American birth cohorts born year 1900 and later, especially the male part of the population seems to become progressively less satisfied with life. In Europe, by contrast, LS seem fairly constant across cohorts.

The concepts of "the good life"

Measuring "the good life" is certainly not an easy task and there is considerable overlapping between the concepts in the literature. Several related terms such as quality of life, well-being, successful aging and life satisfaction are in use. One discussion concerns whether the emphasis should be on subjective or objective criteria (Baltes and Baltes 1990); whether the individuals' own evaluation of his life is enough or if there should be outside criteria to be met? It has been argued that the human psyche is so very plastic and adaptive and therefore only subjective criteria is not enough to estimate "the good life". In the literature, it is hard to draw clear lines between LS, QoL and SWB (Berg et al, 2006). The concept LS used in this thesis, however, is based upon the subjects' own evaluation of his life. Below is a brief description of the different concepts mentioned above (see fig 2).

Quality of life

QoL is a term used in diverse areas; medical as well as political and economical. There are over 100 definitions of the concept (Cummins, 1997). Most of these definitions include one subjective part, similar to LS, and one multidimensional objective part.

WHO, needing a measure by which to compare well-being cross-culturally, defined QoL as: "The individuals' perception of their position in life, in the context of cultural and value system in which they live and in relation to their goals, expectations, standard and concerns" (WHOQOL, 1995). The concept includes six domains: physical, psychological, social relationships, independence, environment and spirituality (WHOQOL, 1998).

Later, WHO added a part specific for elderly (Power et al, 2005). In addition to the original facets, six facets were added considered of special importance to an elderly population: sensory abilites, autonomy, past, present and future activities, social participation, death/dying and intimacy.

Among the four concepts mentioned above, quality of life and successful aging are probably the most similar as both seek to include objective as well as subjective estimates of the individuals' life. SWB and LS are thus subjective parts of the bigger concept QoL that also includes objective measures (fig 2).

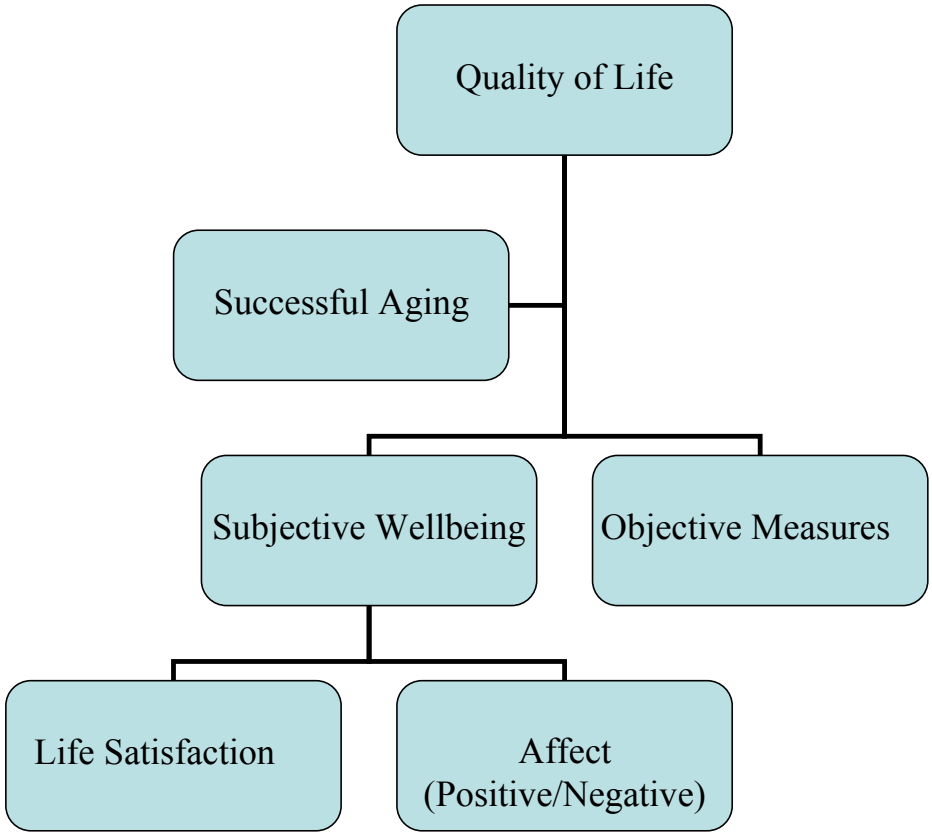

Figure 2. *Relations between the concepts*

Successful aging

There is no consensus definition when it comes to the concept successful aging. Rowe and Kahn (1987) defined SA as containing three domains: avoidance of disease and disability, maintenance of high physical and cognitive function and sustained active involvement and engagement in life. Paul Baltes defined SA simply as "doing the best with what one has".

Jeste and Depp (2010) identified 28 studies on SA including more than 100 participants. In these, 29 different definitions of SA were found and the rate of elderly meeting the criteria differed between 0.4 and 96%! The median percentage though, was 35% which is similar to numbers seen in other studies. The only more or less consistent criterium was physical health and freedom from disability. Research on successful aging often include length of life, health; mental and biological, cognitive abilities, social life, personal control and LS. Factors limiting people from being meeting SA-criteria is more often the presence of chronic disease or disability than lower cognitive abilities or lack of social connectedness.

Most elderly do not meet the objective criteria for successful aging, while the majority meets the subjective criteria. For example, Depp and Jeste (2010) asked

almost 2000 women over the age 60 to rate themselves from 0 (very unsuccessful aging) 10 (very successful aging). The vast majority, 90%, rated themselves at seven or above. On the individual level it is of course good if an individual is content with his life even under circumstances objectively considered "negative", but for the planning of health care and environments meant to enhance successful aging, objective criteria are useful in this concept as well.

Subjective well-being

Diener (1984) defined SWB as consisting of two main components, one affective including positive as well as negative affect and one cognitive, LS. Diener incorporated "subjective" in the well-being concept to underline the importance of assessment by the individual.

Life satisfaction

According to Diener (1984) LS is "a cognitive judgmental global evaluation of one's life. It may be influenced by affect but is not itself a direct measure of emotion". Among the above concepts, LS is the most narrow. Underlining the overlapping of the concepts were Neugartens' considerations (1961) when having constructed her scale; choosing between "morale" and "psychological well-being", she finally landed on LS. Measuring the good life is obviously not an easy task and it can be studied from many angles.

Selective optimisation with compensation

Baltes and Baltes model of selective optimization with compensation, SOC (Baltes and Baltes, 1990), was chosen as theoretical framework for the interpretation of findings in this thesis. It could be fathomed, though simplified, in the simple phrase "choosing that which is most important". The SOC strategy has mostly been applied in research on cognition but it has also been extended to the setting of chronic disease (Gignac et al, 2002) and the three mechanisms of adaption have been shown useful in an elderly population facing disability and pain.

SOC was created as a "prototypical strategy of successful aging" (Baltes and Baltes, 1990), or a psychological model for the study of successful aging. The process it describes is at work at any time in human development but becomes increasingly important as losses in biological, mental and social reserves increase and there are negative changes in the ratio between gains and losses.

Selection refers to active as well as passive processes through which the individual is restricted to fewer domains of functioning. It can be caused by for example disability, or it can be an active choice to focus on areas of high priority. *Optimization* means investing in behaviours that augment and maximize reserve capacities and quality of life. A simple example would be physical exercise aiming at maximizing physical strength. Finally, *compensation* of different kinds and in different areas; medical, psychological or technological, become vital as abilities and opportunities are lost. Paul Baltes argued that as for example fluid intelligence or functional abilities decline with increasing age, crystallized abilities can increase, and to various extent compensate for losses and help the individual age successfully. (Baltes, 1993) Baltes himself was fond of telling the story of the

concert pianist Artur Rubinstein to illustrate the SOC-theory. Rubinstein was interviewed in TV at age 80 and was asked how he could continue to play the piano at such a high level at such advanced age. Rubinsteins' answer was that he chose fewer pieces out of his vast repertoire (selection). Then he practiced those pieces more (optimization). Finally, when approaching a very quick passage in a piece, he reduced speed in the passage ahead to create a contrast that made the listener believe he played as fast as he did when he was younger (compensation).

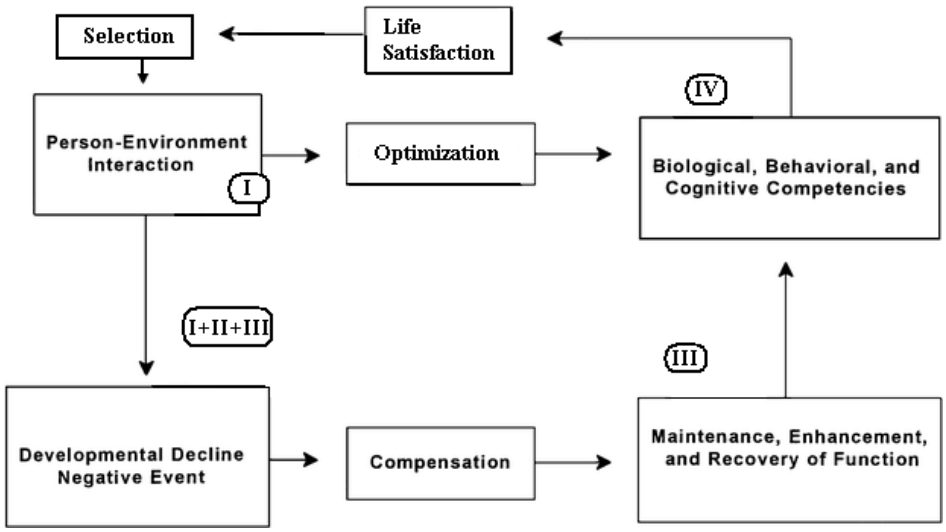

Fig 3. *Studies I-IV integrated in the SOC model. (Modified from Schulz and Heckhausen, 1996)*

Instruments related to life satisfaction

Multiple instruments for assessing the various aspects of "the good life" have been constructed. The WHOQOL-OLD scale (2005) is one example of an instrument that has been used widely all over the world. SF-36 and its' derivative SF-12 is another well-known instrument that assesses health related quality of life divided into a physical and a mental component (Ware and Sherbourne, 1992). It has been argued that in the oldest-old such instruments give a too negative picture of QoL since health is often compromised, not necessarily meaning that well-being is reduced. In this thesis the chosen outcome measure was Neugartens' LS-index since we wanted an instrument capturing the individuals' own evaluation of his/her life, and an instrument relatively devoid of the influence of social participation, activity and health issues.

The Neugarten life satisfaction instrument

Life Satisfaction Index A was thus used as outcome variable in this thesis. It was created in 1961 by Bernice Neugarten and her colleagues in Chicago University,

USA. Neugartens' aim with the instrument was to create a measure of successful aging using the individuals' evaluations as reference point, relatively independent of various other psychological and social variables such as activity levels.
Neugarten defined LS in five main components. The first, *zest*, represents enthusiasm about relationships or activities. The opposite is apathy; feelings of boredom and monotony. The second item is *resolution and fortitude*, meaning the subject takes active and personal responsibility for the life that has been. A low score on this item is given for a feeling of helplessness and being intra- or extrapunitive. *Congruence between desired and acquired goals* is component number three as opposed to a respondent who feels he missed most opportunities in life. *Self-concept* is the fourth item with perception of self as a socially, psychologically and physically attractive person versus one being endured by others. The last item is *mood tone* – being happy and optimistic versus irritable, low-spirited and bitter. Neugarten and colleagues did no factor analysis on the instrument, but several factor analyses have been carried out and different solutions have been proposed (Liang, 1984; Hoyt and Creech, 1983). Many studies using Neugartens' instrument have used the LSI-Z version (e.g. Berg et al 2006), which is shorter, containing only 13 questions. In this thesis, we worked with the whole instrument since it's not entirely clear what factors that represent the concept LS optimally.
The instrument was constructed based on interviews with people between ages 50 and 90. Initially, subjects were interviewed and scores were set by a third person reading the interviews. To validate results, a clinical psychologist later interviewed subjects in depth and rated LS. Interestingly, correlations for the two ratings were 0.70 for people aged 70 and above compared to r=0.53 for those aged 69 and below. The phenomenon was repeated when comparing LSI-A to LS-ratings by a psychologist – r was 0.05 for people younger than 65 and 0.55 for persons over 65. The conclusion was that the indexes are more suitable for persons over age 65.

Factors related to life satisfaction

The field including studies of LS and related concepts is rapidly growing and numerous factors related to LS have been found; psychological, social and health related to mention a few. Concerning the oldest-old, however, studies are more scarce, especially those of a longitudinal design. The correlates included in this thesis were chosen after reviewing current literature, much of which was built on cross sectional studies (Berg, 2006).

The theory of selective optimisation with compensation is a description of a process likely to be ongoing at any time during the human life span, but becomes more evidently applicable in the aging individual due to the many changes faced in this age. Many of the covariates, i.e. functional and cognitive ability and social network can be related to the three aspects of the model. Others, such as depressive mood or number of symptoms can be said to interfere with the individuals' general ability to apply the SOC-strategies.

Study number I approached LS in the oldest-old from a broad perspective including health related as well as social and psychological variables. In studies II-IV, three main independent variables well known to affect geriatric populations, namely symptoms, functional ability and cognition, were studied in relation to LS.

Age

In Neugartens' original work no effect on LS was found depending on age. Hers was however a wealthier and healthier group than average. Despite increasing health problems, losses of loved ones and so on, few researchers have found a strong relationship between age and SWB (Siedlecki, 2008); whether LS changes throughout life or remains stable is a question that has received diverging answers. Hamarat et al (2002) painted a very positive picture in their work on coping strategies and LS, meaning that the oldest-old cope at least as well as their younger counterparts and rate themselves as more satisfied with life as the younger group. However, the three groups compared here contained about 30 participants each and the mean age in the oldest group was 79.1.

Gender

In Neugartens' original study there was no difference in LS between sexes. Berg et al (2006) confirmed this, but found differences in factors affecting LS; in women depressive symptoms and self-rated health were related to LS, whereas widowhood was significantly associated to lower LS in men.

Smith and Baltes (1997) created an index of psychological profile based on variables such as social relations, self and personality factors and intellectual functioning. They found that, among the oldest-old, the relative risk of having a negative profile was 1.25 times higher for women than men.

In a metaanalysis, Pinquart and Sorensen (2001) found that women reported lower SWB on nearly all measures although gender differences decreased when statistically controlling for factors such as widowhood, health and SES.

Symptoms

Few would question that health has an impact on LS, but how does one measure health? One expression of health could be the experienced burden of symptoms. The literature on LS and symptoms in the oldest-old is very scarce. A Swedish study established a connection between number of symptoms and perceived health (Al-Windi 2005), and found LS to be a strong predictor of perceived health. In old ages, perceived health seems more important to LS than medically defined health (Hillerås et al 2001).

Pennebaker (1982) has written much about symptoms although not particularly targeting the oldest-old. He studied the interactions between personality and the reporting of symptoms and concluded that a neurotic personality also has a tendency to report more symptoms than a more extrovert person.

Borglin et al (2004) found pain, fatigue, nervosness/worry and mobility impairments to be the most common health complaints in a studypopulation aged 75-99. They also found clear associations between these symptoms and QoL as well as HRQoL.

Functional ability

Asakawa (2000) concluded that elderly subjects experiencing impairment in functional ability also reported a shrinking social network, increasing depressive symptoms and lower LS than subjects remaining functionally intact. This was confirmed by Bowling and Grundy who found that worse overall health and functional decline were the most significant predictors of lower LS and more depressive symptoms among people aged 65 to 84 years in a three-year follow-up. Personality factors have been discussed in this area too, suggesting that personality traits mediates the impact of impaired functional ability on LS (Borg et al, 2008)

Cognition

Stating that aging affects cognition is hardly controversial. Besides biological theories explaining cognitive decline, different psychological theories have been in use (Dehlin et al, 2000). According to the "use it or loose it" theory, decline comes due to less cognitively demanding activities. The opposite may also be true; that the elderly avoid cognitively demanding activity due to reduced capacity.

Another theory is "the Alienation theory", stating that changes in the environment presents greater challenges for an elderly, leaving him alienated and thus less prone to involve in intellectually stimulating activities. Studies of the effects of cognitive abilities on LS in the general older population are few (St John and Montgomery, 2010). Jones et al (2003) showed a positive correlation between cognitive function, QoL and SWB regardless of education and income. Baltes et al also found that better results on measures of Gf and Gc were correlated to higher internal LoC, less loneliness and higher SWB (Smith and Baltes, 1997).

Gc and Gf display different trajectories throughout the life-span: they both increase dramatically until young adulthood whereafter Gf diminishes while Gc is stable or even increases. Gc represents the impact of socialization and culture and presents itself in wisdom and management of the self with abilities such as reading and writing and professional skills. Fluid abilities are determined by genetical and biological factors (Smith and Baltes, 1997) and in the aging individual, a loss here is inevitable although awareness of training potentials in this area even in the very oldest is growing. Baltes meant that through growth in crystallized abilities, the individual can at least partly compensate for losses in Gf.

Baltes' research on the aging mind (Baltes, 1993) challenged the view that the aging mind is marked only by decline. He was looking for the reserves and potentials of the aging mind. As for Gf, Baltes showed that it is trainable to the same level that the respondent had before age loss set in. This was a fascinating finding that awakened hope. There is however a limit to the training abilities; none of the older participants in Baltes' study (Baltes and Kliegel, 1992) could reach the same results as the younger adults after receiving the same training.

Marital status

In all ages, including old age, marital status is related to LS (Diener, Gohm, Suh and Oishi, 2000). Being married is likely to provide social and intellectual stimulation

and buffer impaired ADL-capacity. Getting married and loosing a spouse are two things that have been shown to have a long–term impact on LS as opposed to many life events that affect LS for only a few months (Suh et al, 1996). Gender differences have been suggested with widowhood affecting the LS of men more than women (Berg et al, 2006). As for number of symptoms, this variable reflects not only present marital status, but the ability to maintain a long-term relationship may reflect personality-traits that per se influences LS positively (Mastekaasa, 1992).

Social network

Social network has been shown to have a strong influence on SWB in late life (Pinquart and Sorensen, 2001). Whether quality or quantity of social network is most important for LS and SWB has been discussed and different researchers have found different answers (Jones et al 2003). Part of the discrepancy can probably be explained with differences in how the aspects of network are assessed. Carstensen (1995) developed the socio emotional selectivity theory describing the tendency for older individuals to choose fewer but more emotionally rewarding contacts. This theory relates well to Baltes SOC-theory as applied on social network.
A well functioning social network has also been shown to diminish depressive symptoms and buffer the threats to LS that reduced ADL-capacity leads to (Newsom and Schultz, 1996).

Depressive mood

Jeste and Depp concluded that "depression interferes with nearly all determinants of successful aging" (2010). Gottfries and Karlsson (2001) reported that in a population above age 65, the prevalence of the clinical condition depression is 12-15 %. Even if the presence of depressive symptoms is not equal to the clinical condition depression, the two concepts are obviously related. Several studies have described that the presence of depressive symptoms increases with age, especially among old-old women (Demure and Sato, 2003, Fiske et al, 2003). Other studies (Tibblin et al, 1990; Al-Windi et al, 1999) have reported that depressive symptoms decrease with age, but few individuals in these latter studies were above 75 years old. The prevalence might be u-shaped with lower prevalence in the young-old age. Depression is naturally negatively related to LS (Blazer et al., 1992, Berg et al 2006) and the presence of depressive symptoms predicts higher risk of mortality (Collins, 2009).

Education

Jones et al (2003) found higher education to be associated with higher LS independent of income. Authors suggested that education might provide tools for personal growth and engagement in life; things that may enhance LS. It is also possible that higher education enriches social life thus affecting LS. Associations between level of education and successful aging were also found by Jeste et al (2010), although factors such as depressive symptoms and self-rate health had a stronger influence.

Socioeconomical variables

In Neugartens' study, those with higher SES had higher LS. Lower SES has been associated with poorer performance on cognitive tests related to Gf as well as Gc. (Rabbitt et al, 1995).

In a metaanalysis, Pinquart and Sorensen (2001) found that income explained 3-4% of variance in SWB. A rather high ability by the elderly to adjust needs to financial assets was discussed.

Health Locus of Control

Rotter (1966) originally assumed that LoC represented a personality trait, meaning one that was stable over time and across different situations. His scale represents a continuum with internal and external at the extremes. An internal tends to believe that he himself has the main control over, and responsibility for, life happenings. An external tends to place the control-place outside of the self, believing factors (e.g. luck or fate), independent of his own behaviour determine outcomes in his life. Later it was found that individuals perceive locus of control differently in different situations, for example regarding health. The health locus of control scale (Walston and Walston, 1976) was then derived from Rotters' Locus of control scale.

LoC, as well as health locus of control, has been shown to affect LS and related concepts (Johansson et al, 2001). Landau and Litwin (2001) showed that among the oldest-old, LoC affects SWB more than social network. The health locus of control (LoC) scale contains three subscales - one assessing internal LoC; the perception that the individual himself has over his health. "LoC power" represents the notion that health status is mainly in the hands of powerful others, such as family members or healthcare professionals. Thirdly, "LoC chance" stands for the belief that personal health is basically determined by luck and/or fate; factors beyond individual control.

Diagnoses

Earlier work has shown a rather weak relationship between "medically based" health and QoL in the oldest-old (Hillerås et al, 2001). Nevertheless, Okun et al (1984) showed that healthy older individuals have a higher QoL than their peers with poorer health. In this thesis we added some diagnoses that are either chronic, very common, or can be expected to impact a persons' life for a longer period of time; stroke, heartfailure, cancer, fracture and dementia.

AIMS

General Aim

The general aim of this thesis was to explore what factors that affect life satisfaction in the oldest-old in general. Further aims were to examine associations between three different areas and LS in this population, namely symptoms, functional capacity and cognition.

***Study I*:** To describe how LS is related to elderly subjects' functional ability and health, to identify factors affecting LS and to what extent they can predict LS during a three year follow-up.

***Study II*:** To describe the frequency and experienced severity of reported symptoms in the oldest-old and how the frequency and burden of symptoms are related to LS.

***Study III*:** To describe changes in functional capacity in a population aged 78 and above during three years and to test the hypothesis that functional decline measured as a diminished ADL-capacity leads to a lower LS in the oldest-old even after controlling for confounders.

***Study IV*:** To explore whether results on 13 cognitive tests separately and organized into six cognitive domains, could predict LS three years later in the oldest-old.

METHODS

Design

The study was designed as a sequential longitudinal population-based cohort study.

Study population

All data was from the study Good Aging in Skåne (GÅS) in which a randomized selection was made from the population register of the respective age group and a letter of invitation was sent out. 2341 individuals aged 78 and above were invited; this yielded 1253 participants (participation rate 53.5%) and 1088 non-participants (fig 4).

Baseline examination started in 2001 and continued until 2003. Reexamination took place between 2004 and 2006. At baseline 1253 individuals, 78 to 93 years old participated. Birthyears for these were between 1908 and 1923. Of those 314 died, eight moved from the area and 250 chose not to take part in the 3-year re-examination. The study population thus consisted of 681 individuals and included six age cohorts: 78, 81, 84, 87, 90 and 93 years. Five municipalities in Southern Sweden were included: Malmo, Eslöv, Hässleholm, Osby and Ystad covering both rural and urban areas. Participants underwent medical examination, questionnaire, neuropsychological testing and functional tests with identical study protocols at both examinations. Information was also gathered from proxy and healthcare staff and validated by medical records. Examination took place either at the research clinic or in the participant's home. Participants had the option to split the examination into three of four different visits if he/she felt the examination to be too extensive to go through in one session. Informed consent was obtained from the participant and when needed from relatives. 551 participants came to the clinic for examination, whereas 73 were examined in their home and 57 at homes for the elderly.

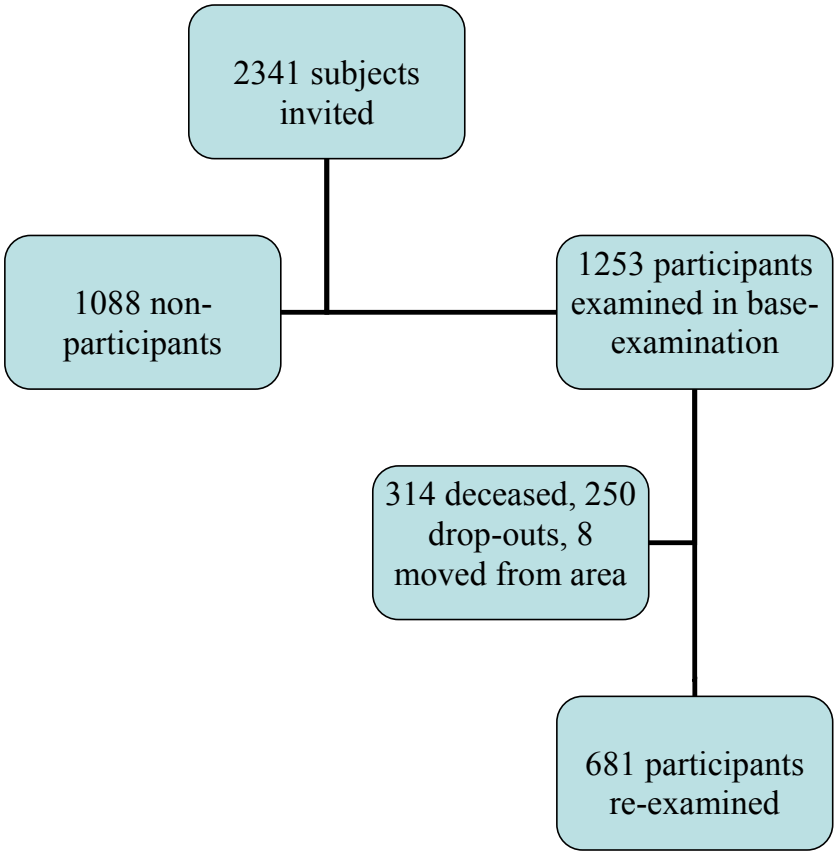

Figure 4. *Flowchart of study population*

DATA COLLECTION

Questionnaires

Life satisfaction

LS was assessed using Neugartens' QoL Scale (LSI-A) (Neugarten et al, 1961). It includes 20 questions, scored from 0 to 2, to which participants had three possible answers to choose from: "disagree", "doubtful" and "agree". A high score thus indicates high LS. If any item was missing, the individual was categorized as missing. LSI-A was constructed to be a valid and reliable instrument measuring general mental well-being in an elderly population. Reliability by Cronbach's alpha for internal consistency was established by Neugarten and later confirmed by Lobello et al. (2004) that found a Cronbach's alfa ranging from 0,85-0,92.

Symptoms

The number of symptoms was rated with a modified version of Tibblins' symptom scale (Tibblin, 1990). The GQoL covers prevalence of 30 common psychological and physical symptoms during the last three months. In study I, only two categories are defined with "no, not at all" categorized as "no" and "yes, a little", "yes, quite a lot" and "yes, a lot" as "yes". In paper II each answer constitutes one category.
The symptoms have been divided into eight domains by Tibblin: depression (exhaustion, sleeping disturbance, general fatigue, low-spiritedness, tearful), tension (irritability, nervousness, impaired concentration, difficulty relaxing, restlessness), gastrointestinal and urinary symptoms (poor appetite, nausea, diarrhea, constipation, abdominal pain, urinary incontinence), musculoskeletal symptoms (pain in the joints, backache, pain in the legs), metabolic symptoms (feeling cold, sweating, weight-loss, overweight), cardiopulmonary symptoms (cough, chest pain, breathlessness), symptoms related to the head (dizziness, headache, impaired hearing, and eye problems).
In the scale used in the GÅS-project, seven additional symptoms have been added to the original scale and it thus covers 37 symptoms (see Appendix B). The symptoms "difficulty walking", "difficulty expressing myself", "difficulty swallowing", "memory impairment" "difficulty urinating", "fecal incontinence" and "slow healing wounds" have been added. This version is used in study I.

In Study II, the same scale was used, but symptoms "difficulty walking", "difficulty expressing myself", "difficulty swallowing", "difficulty urinating" and "fecal incontinence" were left out due to low prevalence. Analyses in study II thus included 32 symptoms. "Difficulty passing urine" and urine incontinence" were made into one domain, and "memory impairment" was made a separate domain, why 10 domains were included in the analysis. If answers were missing for specific items, the individual was assumed not to have that symptom and the score was calculated depending on answers that were filled in.

Functional ability

Functional ability was assessed through self-report according to Hulter-Åsbergs' activities of daily life (ADL) scale, the revised version (1991). The nine activities included in the ADL staircase are divided into four instrumental activities (i-ADL): transportation, cleaning, grocery shopping and cooking, and five personal activities (p-ADL): bathing, dressing and undressing, toileting, mobility and food intake.

For each item, the respondent is given several answer alternatives, for example "can you eat by yourself?" The respondent can choose between "yes, I can eat"; "yes, I can, but I need help cutting the meat, opening packages and so forth"; and "no, not at all". Alternatives are then categorized into independent and dependent according to Sonn and Hulter Åsberg (1991). In this study, the scale was tested and found to have good validity, and reliability was estimated to KR20=0.9 using Kuder Richardssons formula. KR20 is analogous to Cronbachs' alpha and a value above 0.65 is considered acceptable. In our study, Cronbachs' alpha for ADL at baseline was 0.84. In study I, we categorized participants into "independent", "dependent in I-ADL", or "dependent in P-ADL". In study III, we used ADL as a running scale.

The "ADL-staircase" refers to that the activities in the instrument can be arranged cumulatively in the form of a comprehensive 9-step ordinal scale (0-8) where 0 is given for a completely independent individual and 9 to someone dependent in all activities. Individuals needing assistance in activities such as food intake, the highest step, are likely to be dependent in all activities further down the staircase (Hulter Åsberg, 1988). Change of the ADL staircase was calculated as ADL at base-examination minus ADL at re-examination. ADL was assessed with identical protocols at baseline and re-examination. In study III, transportation was excluded due to high attrition for this item. Incontinence was excluded since this has been considered an ability rather than an activity.

Missing was handled accordingly: If just one P-ADL item was marked as "dependent", the person was classified as dependent in P-ADL. If one item representing I-ADL was checked as "dependent" the individual was categorized as I-ADL dependent if all P-ADL was checked as independent. To be categorized as independent, all ADL items had to be checked as independent. As for the staircase, the respondent was categorized as missing if just one item was missing.

Depressive mood

A subscale; Montgomery Åsberg Depression Rating Scale (MADRS), of the Comprehensive Psychiatric Rating Scale (CPRS) (Montgomery and Åsberg, 1979) was used to assess depressive mood. It includes ten questions, each graded in six steps involving depression, anxiety, sleep, appetite, concentration, initiative, emotional involvement, content of thoughts, and basic mood. The score ranges from 0-60 where 0-6 indicates mental well-being and 35-60 indicates severe depressive mood (Snaith and Harrop, 1986). In the GÅS-study, the CPRS-questionnaire is filled-in by an interviewer, but it is still a self-assessment of the mood that the participant experienced for the last three days. It is thus not equivalent to the DSM criteria that require an objective assessment and where symptoms are supposed to have lasted for at least two weeks. Also, the CPRS-scale deals only with the patients' experiences of his/her mood, not considering underlying reasons.

Subjective health

Subjective health was estimated from a 7-graded question "How are you feeling today?" Score one is "much better than usual" and score seven is "much worse than usual".

Social network

Three aspects of social network were defined; a structural measure (frequency of social contacts), a functional measure (quality of social network) and social anchorage. Structure was assessed by the question: “Do you feel the number of friends you have is enough?” Participants could choose between three alternative answers: “too few”, “enough” and “too many”. The first alternative was categorized as a lack of contacts and the last two were categorized as sufficient number of contacts. Quality of social network was estimated by the question: "Do you feel that you have someone or some people who can give you a proper personal support to cope with life's stresses and problems?" Respondents could choose between four alternative answers: “yes, no doubt”, “yes, probably”, “no, probably not”, and “not at all”. The answers were dichotomized into “yes” or “no” where the first two alternatives represent “yes” and the two last ”no”. Social anchorage was estimated by four questions: “If you’re a member of an organisation, would you say that you have a strong sense of coherence with that organisation or its’ members?” “Do you have a strong sense of coherence with your relatives?” “Are you rooted and have a strong sense of coherence with your neighbourhood?” “Are you part of a set of friends that have common interests?” Participants were asked to answer on a four graded scale and the answers were categorized into “yes” if the answer was “yes, very much” or “to some extent”, and “no” if the answer was “not particularly” or “not at all”.

Health Locus of Control

The health locus of control (LoC) scale (Walston and Walston, 1976) contains three subscales - one assessing internal LoC, eg the perception that the individual himself has the main control over his health. “LoC power” represents the notion that health status is mainly in the hands of powerful others, such as family members or healthcare professionals. Thirdly, “LoC chance” stands for the perceived importance of luck and/or fate as main determinant over personal health

Each subscale ranges from 6 to 30 with a higher number meaning more LoC for the respective subscale. In the GÅS-study, it is assessed by 18 questions; six designed to assess each locus of control. Maximum score per subscale is thus 30.

Diagnoses

The occurrence of cancer, fracture, heart disease, stroke and dementia was retrieved from the medical examination, history and medical records.

Hypertension was defined by WHOs’ definition; a blood pressure above 140/90 is considered high. Dementia was diagnosed based on the DSM-IV criteria.

Sociodemography

Those included age, housing categorized into rural, urban or city, gender, education (years), marital status, access to transportation and utilities.

Finances

Private financial resources were assessed by three questions in paper one: "Do your financial means cover your needs?" The answer was fivegraded: "very well", "well", "neither well nor insufficient", "poorly", "not at all". The three first alternatives were categorized as sufficient, and the last two as insufficient. Participants were also asked to by yes or no answer the questions: "Could you, if needed raise 14000 Swedish crowns" (about 1400€, corresponding to one third of a price base amount) and "Have you had difficulties to make ends meet when it came to running expenses during the past year"? In paper three, only the question "Do your financial means cover your needs?" was used to assess financial status.

Cognitive variables

The Mini Mental State Examination (MMSE), ranging from 0 to 30, was used to assess cognitive function (Folstein et al., 1975). Good reliability and validity has been documented for the test (Tombaugh and McIntyre, 1992).

Vocabulary. Semantic memory was measured with a synonym test (SRB1, Dureman 1960). The participant is shown a word to which he is supposed to find the synonym among five alternatives. 30 words are presented; maximum score is 30 and time limit is set to 7 minutes. The test is not perceived to be age-sensitive and reflects Gc (Lezak et al 2004).

Digit cancellation (Lewis and Rennick, 1979) measures aspects of executive function: sustained attention, visual scanning, activation and inhibition of responses (Lezak et al, 2004). Participants are required to cross out a certain digit (in our case digit four), among a number of randomly interspersed numbers in rows during 30 seconds. Maximum score was 43.

Confidence (Allwood, 1994), is a test of the executive abilities which encompasses the ability to plan and organize actions, but also to evaluate and interrupt actions that don't yield desired results. Ten questions are presented to the participant. Each question contains two sentences of which only one is correct. Participant is asked to identify the correct answer and then state how sure he is that he answered correctly. Range 1-10.

Comparing figures measures perceptual speed and visuospatial ability (Lezak et al., 2004). During 30 seconds, the participants are asked to decide whether two figures in 30 different pairs are identical or not. Range 0-30.

Digit span. The digit span test of the Wechsler Intelligence and Memory Scales (Wechsler, 1997) was used to measure working memory (Lezak et al, 2004). The participant is supposed to repeat numbers after the TL – initially two, then increasing numbers in a row. In digit span backwards 14 numbers are presented and the participant is to repeat as many as he can in reverse order. The maximum score is 14.

Word recall and recognition of positions. One at a time, sixteen cards with words are presented to the participant (maximum score 16). Each card is presented for 5 seconds. The positions of the words were randomly varied. After the presentation the participant is asked to recall as many of the words as possible during two minutes. The test reflects episodic and working memory (Lezak et al, 2004). Later the same words are presented with an equal number of new words and the participant is asked to identify those in the original version and in what position the original word was.

Trail making test B, TMT B. In the GÅS-study, a shortened version of the original TMT B is used. The participant is asked to draw a line between correct numbers and/or letters in circles on a paper as fast as possible. The result is measured as seconds needed to complete the task (Lezak, 2004).

Mental rotations measures three dimensional thinking and spatial ability. Participant is shown an index figure and three figures of which one is identical to the index, only rotated and identify the latter, score 0-10. (Modified from Shepard and Metzler, 1971.)

Verbal fluency was measured by four tests (Lezak, 2004). In *category fluency*, participants were asked to generate as many animals and occupations as possible in 60 s. For the *letter fluency* tasks, participants were given 60 s to generate as many words as they could, beginning with the letter A and F, respectively.

The cognitive tests were organized into five domains accordingly:

1. "Executive" (Including TMTB, the verbal fluency tests and confidence.)

2. "Processing speed" (Including digit cancellation and comparing figures.)

3. "Episodic memory" (Including word recall.)

4. "Spatial" (Including mental rotations).

5. "Working memory" (Including digit span forwards and backwards.)

A sensitivity-test was done regarding the correlations between LS and the cognitive tests. When tests were performed, the test leader filled in a protocol registering whether eyesight, hearing, motor or communicational problems might have interfered with the testing. About one third of the group was noted to have such a problem. The correlations were made again after excluding this group but the results were not significantly different from when this group was included. Therefore, in the subsequent analyses, subjects with eyesight, hearing, motor and communication-problems were included.

DATA ANALYSIS

Data analysis was performed using SPSS software version 17, 18 and 20. All statistical tests were two-sided.

Students' t-test was used to test differences in mean values of LSI-A for a number of variables in the baseexamination in paper I, III and IV. The LSI-A was normally distributed.

Chi-2 test was used in study III to calculate differences in proportions in ADL-change between men and women, the younger and the older agegroup, higher/lower education and married/single.

ANOVA was used in paper III to compare mean LSI-values for functionally impaired, unchanged and improved in each group stratified by gender, age, marital status and education. In paper one, ANOVA was used to test differences in LSI-A means between ADL categories.

Pearsons' correlation coefficient was used in paper II to test correlations between LSI-A at re-examination and four-graded symptoms and groups of symptoms at baseline. Pearson was also used in paper IV to calculate correlations between cognitive variables and cognitive domains at baseline and LS at follow-up.

Spearman's rho was used in paper I and III to test correlations between age, MMSE, difference in ADL, number of symptoms, self-rated health, social anchorage, CPRS and LSI-A.

To make scales of different cognitive tests (study IV) comparable when organized into domains, they were transformed using z-standardisation according to $z=x_i-m/SD$. (X_i = individual, m=mean, SD=standarddeviation.)

In paper I, a logistic linear regression model was constructed in order to consider possible predictors of LS, and regression coefficients were calculated. All factors were included in the model.

In paper II, III and IV, linear multiple regression models were constructed with LSI-A-score at re-examination as dependent variable. Regression coefficients and p-values were calculated. Level of significance was set to $p<0.05$.

In paper III, independent variables included in the linear multiple regression model were those which showed significant correlations to LSI-A when level of significance was set to $p <0.2$. The higher level of p-value, compared to the more common value of <0.05, was chosen in order to reduce the risk of excluding variables that might have a decisive influence on LS.

ETHICAL CONSIDERATIONS

Studies I-IV were approved by the regional ethics committee at Lund University 2010-2012, Registration no. LU 744-00 and all subjects provided a written consent to participate in the study allowing retrieval of information from the National Patient Register medical records.

RESULTS

Independent variables shown to predict LS after adjustment for confounders in this thesis were the number of symptoms and specific domains of symptoms namely depressive, tensive, gastrointestinal and musculoskeletal symptoms. Also predictive of LS were functional ability, cognitive domains processing speed and mental rotations, locus of control, age and marital status. Further, higher education was associated with LS, significant on the 0.05 level in Study III. Main independent variables; namely number of symptoms, functional ability and cognitive ability expressed by processing speed and spatial ability were analysed to see if there were significant interactions between them but no such were found.

The study population consisted 418 were women and 263 men, 488 were between 78 and 84, and 193 were between 87 and 93 years old. 16 individuals answered that they had had difficulties to make ends meet when it came to running expenses during the last year; 648 had not. 567 individuals said they, if need be, could raise 14000 SEK within a week, while 94 said they could not. Characteristics of the study population and LSI-A scores for subgroups are described in table 1.

Table 1. *Characteristics of study population and comparison of life satisfaction index (LSI-A) at base examination regarding sex, residence, marital status, education, age groups and functional ability by ADL*

		LSI-A	
Variables	**n**	**Mean/SD (n)**	**p-value**
Sex			
Men	263	26.9/ 6.4 (247)	
Women	418	25.2/6.7 (389)	0.003
Residence			
Urban	584	26.0/6.6 (557)	
Rural	87	25.3/6.7 (78)	0.444
Marital status			
Married/cohabiting	266	27.4/6.1 (259)	
Single/widowed/divorced	404	24.8/6.8 (376)	<0.001
Education			
≤ 9 years	436	25.1/6.6 (410)	
> 9 years	231	27.4/6.5 (224)	<0.001
Age groups			
78-84	488	26.2/6.6 (468)	
87-93	193	25.1/6.6 (168)	0.073
ADL			
Independent	299	27.5/6.0 (293)	
Dependent, instrumental ADL	240	25.1/6.8 (235)	
Dependent, personal ADL	111	23.0/6.8 (100)	<0.001

Significance tested with Students t- test and ANOVA.

Description of Life Satisfaction Index A in the thesis

The LSI-A was almost normally distributed (fig 5). At baseline 636 subjects filled in the LSI-A; the mean value was 25.9 (SD was 6.6). Median for LSI-A at base-line was 27.0 with the first quartile at 21 points and the third at 31 points. When people with a diagnosis of dementia at base-line (n=38) were excluded from analysis, mean LSI-A value was 25.9; for the dementia group the mean value was 24.8.
In our material Cronbachs' alpha for LSI-A was 0.78.

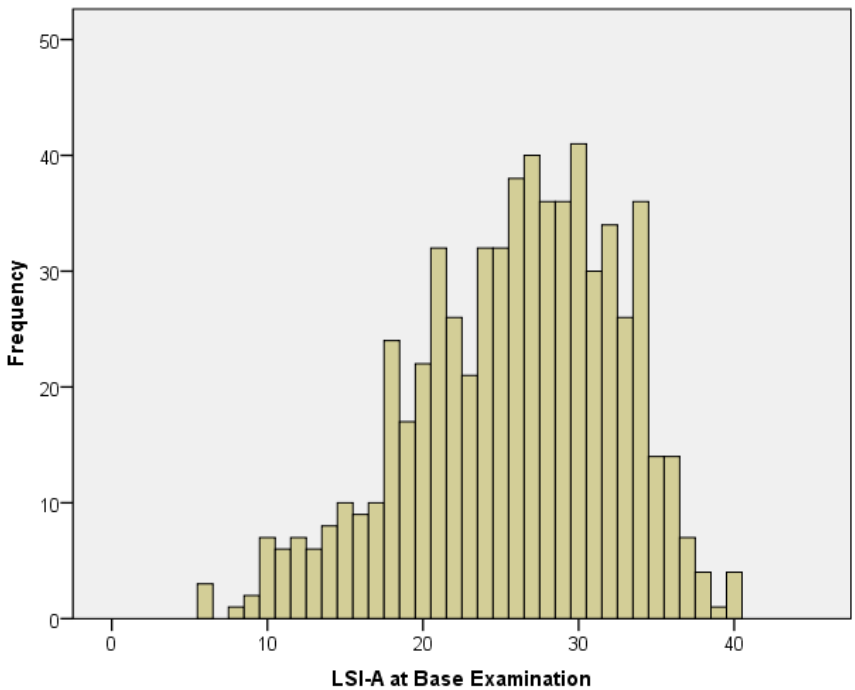

Figure 5. *Histogram showing mean values of LSI-A at baseline for the study population*

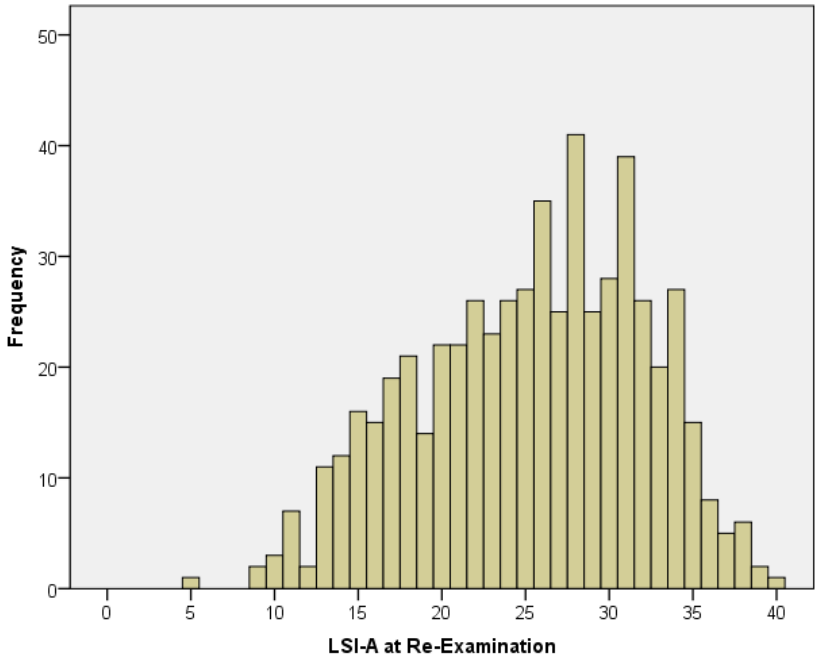

Figure 6. *Histogram showing mean values of LSI-A at reexamination for the study population*

At re-examination n for LSI-A was 572 with a mean value of 25.3 (SD 6.7). At re-examination, median for LSI-A was 26, with the first quartile at 20 and the third at 31. The mean change in LSI-A from baseline to re-examination was one score, SD 5.5 (Fig 7).

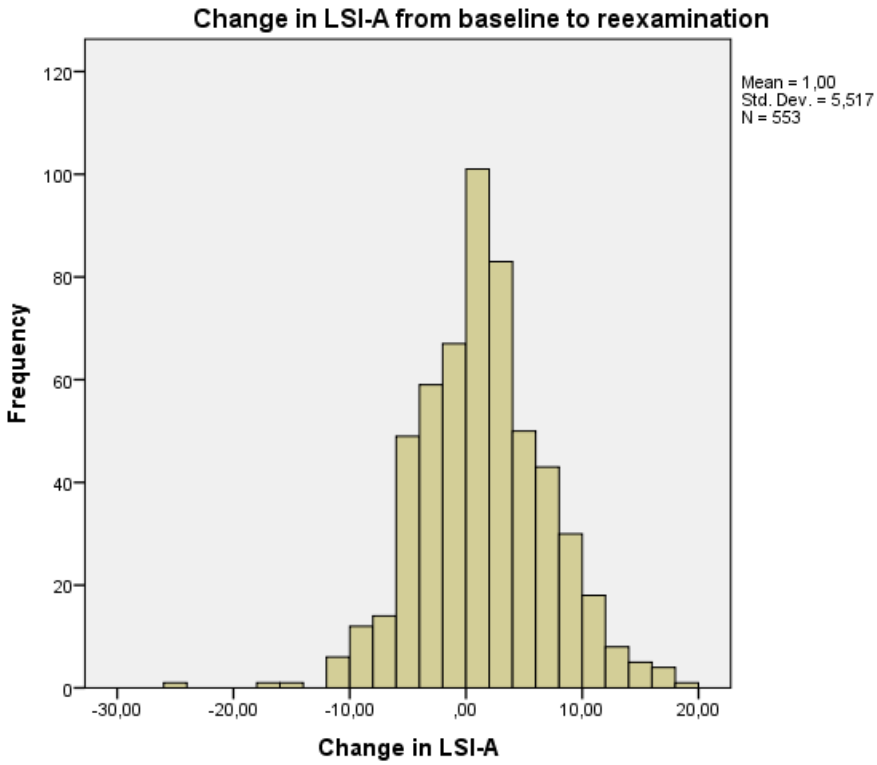

Figure 7. *Histogram showing change in LSI-A from baseline to re-examination*

Life satisfaction in the oldest old (Study I)

Descriptions of the study population and LSI-A are presented in table 1. Stratifying for age and sex, the score was 26.9 for 78 to 84-year-old men as well as for 87 to 93-year old men at baseline. For women it was 25.7 at age 78 to 84 and 24.1 at 87 to 93.

Higher mean values of LS were noted among participants that were married/cohabitant, those with higher education, those reporting good economy and larger quantity or higher quality of social network, those independent in ADL and those without fracture.
The strongest positive correlations were noted between LSI-A and social anchorage (r=0.298) and internal LoC (r=0.207). Positive correlations were also noted between LoC power, higher MMSE-score, better functional capacity and better self-rated health and LSI-A. The strongest negative correlations were found between number of symptoms (r=-0.366) and depressive mood (r=-0.274) and LSI-A (Table 2).

	LSI-A at base-examination		
Variable	**n**	**R**	**p-value**
Age	636	-0.119	0.003
Locus of Control			
chance	629	-0.092	0.021
power	629	0.105	0.009
internal	632	0.207	<0.001
Cognition (MMSE)	608	0.127	0.002
Number of symptoms	627	-0.366	<0.001
Worse subjective health	635	-0.116	0.004
Social anchorage	627	0.298	<0.001
Depressive Mood,(CPRS)	593	-0.274	<0.001

Table 2. *Correlations between Life Satisfaction Index A (LSI-A) and age, health locus of control, (chance, power, internal), MMSE, number of symptoms, self-rated health, social anchorage and CPRS. (r=Spearmans' correlation coefficient rho.)*

49% of women and 56% of men at 78 to 84 years old were completely independent in ADL compared to 27% of women and 42% of men of 87 to 93 years of age. LSI-A in the ADL independent group did not differ between age 78 to 84 and 87 to 93 and for those who remained independent in ADL at follow-up the mean LSI-A score was unchanged. LSI-A of ADL-independent was significantly higher than the LSI-A of ADL-dependent in both men and women in age group 78-84.

LSI-A was dichotomized into the highest tertile vs the lower tertiles. 149 individuals scored in the highest tertile. The lowest tertile included scores up to 24 points, and the highest scores from 29 and above. In a logistic multiple regression model it was tested what factors in the base-examination that could predict LS three years later. All variables were adjusted for each other. Analysis was conducted to rule out multicollinearity. A higher number of symptoms, higher age and depressive mood were associated with lower LS whereas being married or cohabiting and higher internal and powerful others locus of control were positively associated with LS (Table 3). Coefficient of determination (Nagelkerkes' R square) for this model was 0.29.

Table 3. *Logistic multiple regression model with independent variables from the base examination and LSI-A at re-examination dichotomized by the highest tertile.*

Variable	B-koefficient	p-value	OR	95% CI
Sex	-0.101	0.688	0.904	0.552-1.480
Age, (decade)	-0.052	0.010	0.949	0.913-0.987
Number of symptoms	-0.075	0.001	0.927	0.887-0.969
Walking aids	0.073	0.795	1.076	0.618-1.874
MMSE	0.061	0.227	1.063	0.963-1.173
Subjective health	-0.391	0.070	0.677	0.443-1.033
Residence, rural/urban	0.573	0.157	1.773	0.802-3.920
Education, ≤9 yrs/>9 yrs	0.290	0.059	1.336	0.989-1.805
Married/cohabiting vs single	-0.538	0.031	0.584	0.358-0.952
Economical sufficiency	0.042	0.865	1.043	0.641-1.697
Locus of control-chance	-0.025	0.286	1.026	0.979-1.075
Locus of control-internal	0.090	0.006	0.914	0.857-0.975
Locus of control-power	0.066	0.029	0.936	0.882-0.993
Depressive mood	-0.086	0.014	0.918	0.857-0.983
Social anchorage	0.223	0.061	1.249	0.990-1.557
Quality of social network	0.207	0.611	1.229	0.554-2.728
Quantity of social network	-0.192	0.517	0.826	0.462-1.474
Dementia	-0.278	0.235	0.757	0.478-1.199
Fracture	-0.194	0.472	0.824	0.486-1.397
Stroke	-0.243	0.600	0.784	0.316-1.945
Cancer	-0.075	0.795	0.928	0.526-1.636
Cardiac disease	0.366	0.169	1.442	0.856-2.431
ADL in three groups	-0.090	0.651	0.914	0.620-1.348

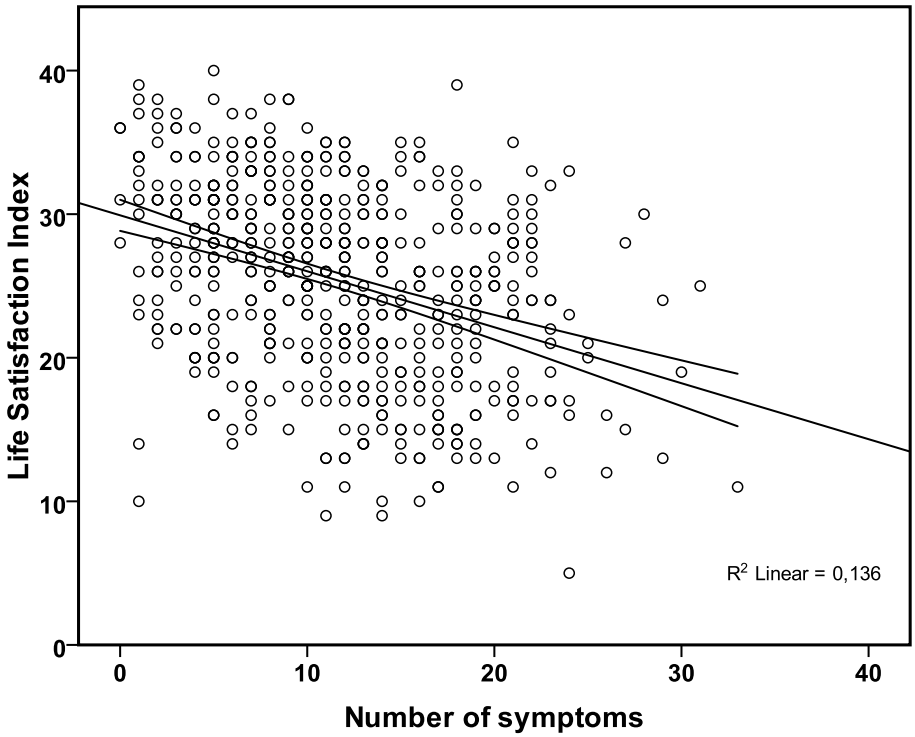

Figure 8: *Correlation between number of symptoms and Life Satisfaction Index A*

Life satisfaction and symptoms (Study II)

Only four persons (0.6%) of the study population claimed to have had no symptoms at all during the last three months. General fatigue was the most common symptom, 67.7% reported this complaint to some degree. Second most common was memory- and hearing impairment (59.7% and 54.9% respectively.)

	Domain*	Male, 80	Female, 80	Male, 90	Female 90	Total (n)
Tearful	A	18/4	32/8	18/2	28/8	652
Exhaustion	A	9/0	9/2	13/0	7/2	651
Sleep disturbances	A	31/7	35/21	24/4	30/14	652
General fatigue	A	56/9	51/18	51/15	48/22	651
Low-spirited	A	30/5	34/4	27/0	29/5	651
Nervous	B	27/2	34/3	19/0	36/6	648
Difficulty relaxing	B	25/5	41/8	19/3	27/8	651
Irritable	B	39/5	41/4	25/0	36/6	651
Difficulties concentrating	B	31/5	36/4	32/6	34/4	650
Restlessness	B	24/3	25/4	19/1	24/3	651
Poor appetite	C	7/1	11/2	10/4	13/6	652
Nausea	C	5/1	10/1	12/1	10/2	650
Diarrhea	C	10/1	9/3	10/0	8/2	650
Constipation	C	12/4	19/4	26/4	23/8	649
Abdominal pain	C	12/2	21/3	13/3	17/5	650
Pain in the joints	D	39/9	34/19	40/10	30/22	651
Backache	D	32/11	38/20	43/10	32/22	652
Pain in the legs	D	36/14	36/23	43/15	39/22	651
Feeling cold	E	24/4	24/9	28/4	22/9	652
Overweight	E	25/6	34/9	13/3	20/4	652
Weightloss	E	7/2	9/1	12/0	14/3	651
Sweating	E	16/4	19/3	13/1	12/8	652
Cough	F	24/3	17/9	26/1	18/6	651
Chestpain	F	16/1	15/3	28/0	12/2	651
Breathlessness	F	30/5	30/11	31/3	30/13	651
Dizziness	G	25/4	32/7	41/4	34/11	653
Headache	G	11/2	21/3	12/0	19/3	651
Hearing impairment	G	36/19	33/15	47/15	41/26	652
Eyeproblems	G	28/11	37/20	36/23	37/32	629
Memory impairment	H	59/6	47/8	62/10	46/10	650
Urinary incontinence	I	17/3	27/8	26/4	32/14	653
Difficulty urinating	I	13/4	4/1	18/4	4/0	652

Table 4. *Prevalence of symptoms (%) among elderly men and women with degree of severity categorized in two groups as mild/moderate and high.*

**Symtpoms arranged into domains by Tibblin (1990): A – depressive, B – tensive, C – gastrointestinal, D – musculoskeletal, E - metabolical, F – heart/lung, G – symptoms related to head, H – memory, I – urinary symptoms.*

The symptoms were categorized into predefined groups. The group that most 80-year old men and women and 90-year old men reported mild symptoms from was symptoms related to the head. For women in their 90s, tension-symptoms were the commonest to have in a mild form. In both age-categories, and for both genders, the metabolic symptoms were the commonest to have to a more severe degree.

The strongest correlations between LS and single symptoms were noted for general fatigue ($r=-0.310$, $p<0.001$) and being low-spirited ($r=-0.266$, $p<0.001$), both symptoms included in the depression domain.

As for domains of symptoms, the strongest negative correlations to LS were found for the depressive symptoms with $r= -0.38$, which gives an r^2 of 0.144. Symptom-groups tension, musculoskeletal and GI-tract were also significantly associated to LS with correlation coefficients near -0.3 (table 5) and thus explains about 9% of variance in LSI-A in this model.

Symptom-group	**r**	**p-value**	**Number**
Depression	-0.379	<0.001	559
Tension	-0.299	<0.001	558
GI-tract	-0.289	<0.001	558
Musculosceletal	-0.291	<0.001	560
Metabolic	-0.218	<0.001	559
Cardiopulmonary	-0.189	<0.001	560
Symptoms rel. to head	-0.247	<0.001	559
Urinary	-0.074	0.080	560
Memory impairment	-0.099	0.020	560

Table 5. *Spearman correlation coefficients between the nine domains of symptoms at baseline and LSI-A three years later*

A linear multiple regression analysis was carried out (table 6) with LS-score at re-examination as dependent variable and all the nine different symptom-groups at baseline as independent variables. Analysis ruled out multicollinearity. Depression, tension, GI-symptoms and musculoskeletal symptoms were significant at the 0.05 level (Table 6). Unadjusted R^2 for the regression model was 0.20.

Symptom-group	B	p-value
Depression	-0.661	<0.001
Tension	-0.338	0.017
GI-tract	-0.821	<0.001
Musculo-sceletal	-0.334	0.031
Metabolic	0.159	0.563
Cardiopulmonary	0.222	0.356
Head-symptoms	-0.215	0.194
Urinary	0.112	0.707
Memory impairment	0.014	0.875

Table 6. *A linear multiple regression model with symptoms as independent variables and life satisfaction index three years later as dependent variable*

Life satisfaction and functional capacity (Study III)

177 individuals (30%) reported impaired ADL-function three years later, 82 of which were impaired by one step, 44 two steps, 24 three steps, 13 four steps, 8 five steps, 4 six steps and 2 seven steps. In average this group had declined with 1.7 steps in ADL-function. 367 individuals (62%) reported unchanged ADL.

The whole study population was impaired with a mean value of 0.6 steps in the ADL-staircase during the three years. The younger group; individuals aged 78-84 years, were impaired with 0.4 steps compared to the older group; individuals aged 87-93, that decreased with 1.0 steps (p<0.001). The greatest decline in ADL was, as might be expected, in the older group in which 51% reported a decline during the three years compared to 23% among the younger subjects (p<0.001).

	ADL-function			
	Unchanged(%)	**Impaired (%)**	**Improved (%)**	**p-value**
Sex Male/ Female	131/ 236 (58.5/ 64.8)	72/105 (32.1/ 28.8)	21/23 (9.4/ 6.3)	0.209
Age 80/90	309/ 58 (69.8/ 40.0)	103/74 (23.3/ 51.0)	31/13 (7.0/9.0)	<0.001
Marital status Married/ Single	152/ 215 (64.4/ 61.3)	65/ 111 (27.5/ 31.6)	19/ 25 (8.1/ 7.1)	0.557
Education Elementary/Highschool _University	236/ 230 (62.4/ 62.5)	117 /59 (31.0/ 28.4)	25/ 19 (6.6/ 9.1)	0.488
Cleaning	515 (75.7)	105 (15.4)	15 (2.2)	
Grocery shopping	521 (76.6)	102 (15.0)	16 (2.4)	
Cooking	515 (75.7)	92 (13.5)	30 (4.4)	
Bathing	572 (84.1)	63 (9.3)	4 (0.6)	
Dressing	599 (88.1)	33 (4.9)	6 (0.9)	
Toileting	593 (87.2)	41 (6.0)	5 (0.7)	
Mobility	630 (92.6)	24 (3.5)	0	
Food intake	641 (94.3)	5 (0.7)	0	
ADL scale	367 (54.0)	177 (26.0)	44 (6.5)	

Table 7. *Changes in ADL-functioning broken down by sex, age, marital status, education and included sub-items. Differences in proportions tested with Chi-2 test*

Differences in mean LSI-value stratified for sex, age, marital status and education was compared for unchanged, impaired and improved ADL-function (table 8). The group that reported impaired ADL had a mean LSI-value of 23.0 compared to 26.4 in the group that was unchanged ($p<0.001$) (table 8). There were significant differences in LSI-A between all groups except for the married group. Post hoc tests (Tukey) revealed significant differences at < 0.05 level between unchanged and impaired ADL for men, women, 87-93 year olds and the group with lower education. For 78-84-year olds, singles and higher educated, differences were significant between unchanged and impaired ADL as well as for impaired and improved ADL. For married, there were no significant differences depending on change in ADL.

	LSI-A value			
ADL:	**Unchanged**	**Impaired**	**Improved**	**p-value**
Male	27.3 (6.6)	24.4 (7.3)	27.6 (7.2)	0.017
Female	25.9 (6.1)	22.0 (6.7)	25.4 (5.5)	<0.001
Age				
78-84	26.4 (6.4)	23.5 (7.6)	27.5 (6.0)	<0.001
87-93	26.5 (6.0)	22.2 (6.0)	23.7 (7.3)	0.002
Marital status				
Married	27.3 (6.6)	25.6 (6.4)	27.2 (7.1)	0.233
Single	25.7 (6.0)	21.1 (6.9)	25.9 (5.8)	<0.001
Education				
Elementary	26.0 (6.3)	22.2 (7.1)	24.6 (5.7)	<0.001
Highschool/ University	27.3 (6.3)	24.3 (6.8)	28.8 (6.7)	0.008

Table 8. *Comparison of mean LSI-A value at re-examination for unchanged, impaired and improved ADL stratified by sex, age, marital status and education. Differences in means tested with ANOVA, SD in parenthesis.*

A higher mean value of LSI-A was noted for male gender, lower age, being married, higher education, being without walking aids, better economy, managing without help from family or social services, partaking in different activities and no depressive mood. A negative correlation was found between LSI-A and impaired ADL, higher locus of control chance, a higher number of symptoms and depressive symptoms in contrast to a positive correlation with LSI-A for locus of control internal and power.

In a linear multiple regression model difference in ADL, depressive mood, number of symptoms, health LoC, education and marital status in the base-examination explained levels of LS three years later (table 9). The whole model explained 31% of variance in LSI-A.

Variable	**B-coefficient**	**p- value**
Female/male sex	0.438	0.474
Age	-0.128	0.086
Married/cohabiting vs single	-1.370	0.028
Education elementary/secondary	1.182	0.035
Economical sufficiency, no/yes	1.225	0.054
Depressive mood yes/no	1.826	0.014
Number of symptoms	-0.336	<0.001
Locus of control-internal	0.239	0.001
Locus of control-power	0.153	0.019
Social activities, no/yes	1.178	0.234
Cultural activities, no/yes	1.155	0.111
Leisure time activities, no/yes	0.808	0.361
Help by relatives no/yes	-0.304	0.692
Help by social services no/yes	-1.942	0.058
Walking aids no/yes	-1.205	0.099
Change in ADL scale	-1.316	<0.001

Table 9. *A multiple linear regression model with independent variables from base examination and Life Satisfaction Index A three years later as dependent variable.*

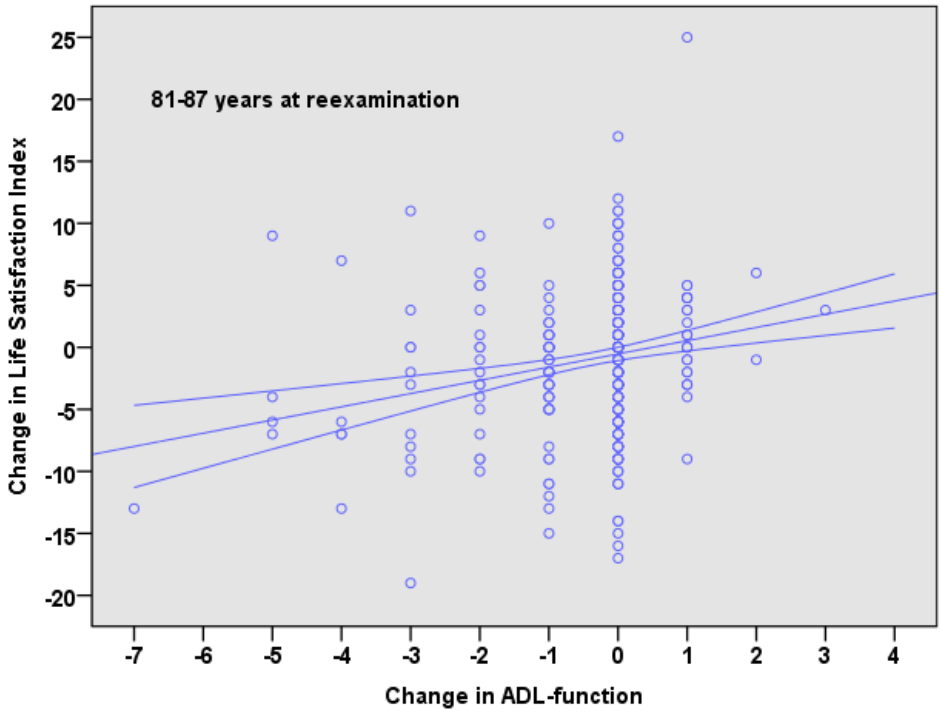

Fig 9. *Change in LSI-A from base-examination to re-examination depending on change in ADL in the same period. Pearson correlation for the younger group, 81 to 87 years at re-examination, was r=0.207, (p<0.001).*

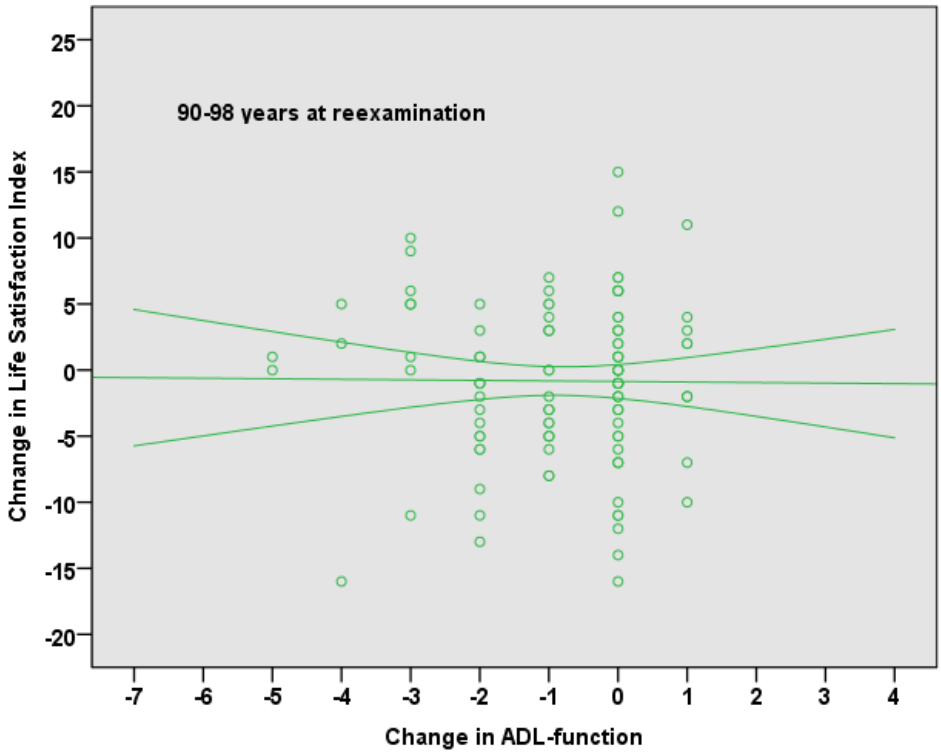

Figure 10
Correlation between change in ADL and change in LSI-A for the older group (90-98 yrs at reexamination). r=-0.009; p=0.921

Life satisfaction and cognition (Study IV)

Attrition analysis showed that the re-examined group had significantly higher mean values on all cognitive tests except mental rotations than the drop-out group at baseline (table 10).

	Study population		**Dropout**			
Cognitive variable	**mean (SD)**	**n**	**mean (SD)**	**n**	**p-value**	**Range**
Age	83.0 (4.4)	681	85.4 (4.8)	572	<0.001	-
(1) TMT B	52.8 (40.5)	560	61.6 (41.9)	345	<0.002	-
(1) Verbal fluency F	12.6 (5.2)	624	10.9 (5.1)	428	<0.001	-
(1) Verbal fluency A	9.8 (4.9)	623	8.2 (4.5)	425	<0.001	-
(1) Verbal fluency, animals	17.3 (5.8)	628	14.9 (5.8)	434	<0.001	-
(1) Verbal fluency, occupations	12.8 (4.6)	621	10.6 (4.4)	429	<0.001	-
(1) Confidence	6.4 (1.6)	627	6.1 (1.6)	432	<0.001	0-10
(2) Digit cancellation	14.3 (3.8)	582	13.3 (4.0)	365	<0.001	-
(2) Comparing figures	9.8 (3.2)	569	8.6 (3.3)	355	<0.001	0-30
(3) Synonym test	19.1 (6.2)	605	17.2 (6.3)	385	<0.001	0-30
(4) Word recall	5.8 (2.1)	594	5.0 (2.3)	395	<0.001	0-16
(5) Mental Rotations	5.5 (1.7)	557	5.4 (1.6)	343	0.420	0-10
(6) Digit span, forward	6.0 (1.7)	616	5.7 (1.7)	424	0.015	-
(6) Digit span, backward	4.9 (1.8)	613	4.5 (1.9)	421	<0.001	0-14

Table 10. *Results on cognitive tests, mean value and SD at baseline for the study population and dropout group. *Differences in numbers could mainly be explained by vision impairment and dementia. **Number preceding test indicate what cognitive domain the test relates to: (1) executive abilities, (2) processing speed (3) semantic memory, (4) episodic memory (5) spatial abilities and (6) working memory*

To explore confounding, Pearson correlations between cognitive tests at baseline and LSI-A at re-examination were calculated for the whole group as well as stratified for stroke yes/no, and depressive mood high/low, education high/low and independence/dependence in functional capacity. For the whole study-population, digit cancellation, comparing figures, word recall, verbal fluency A, mental rotations and verbal fluency animals and occupations were significantly correlated to LSI-A.

Correlations were also calculated for age groups 78-84 and 87-93, dementia (yes/no) and sex. While significant in the 78-84 group, the verbal fluency tests and comparing figures lost association to LSI-A in the older group. In both sexes there were similar significant associations between cognitive results and LSI-A. Stratification for dementia did not affect the correlations significantly.

Correlations were calculated between cognitive domains and LSI-A three years later data not shown). The strongest correlations with LSI-A were found for processing speed, r=0.15, p=0.001, R^2=0.02 (fig 9), and spatial abilities; r=0.16, p=<0.001, R^2=0.03. Executive abilities (r=0.12) and episodic memory (r=0.10) were also significant at p <0.05-level. Semantic and working memory were not significantly related to LSI-A.

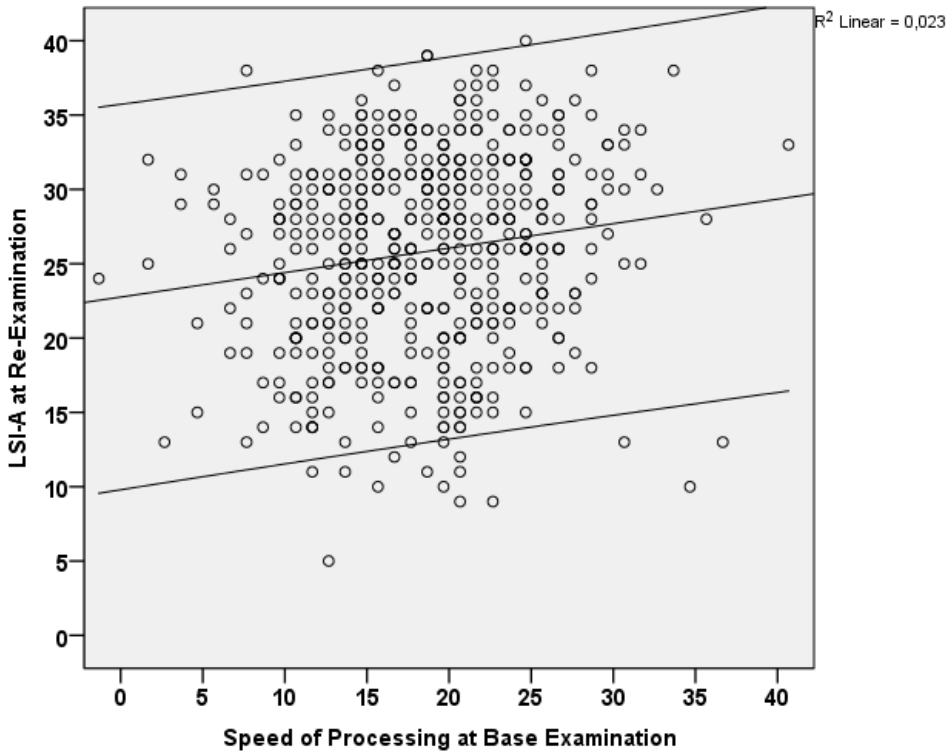

Figure 9. *Scatterplot showing association between LSI-A and processing speed*

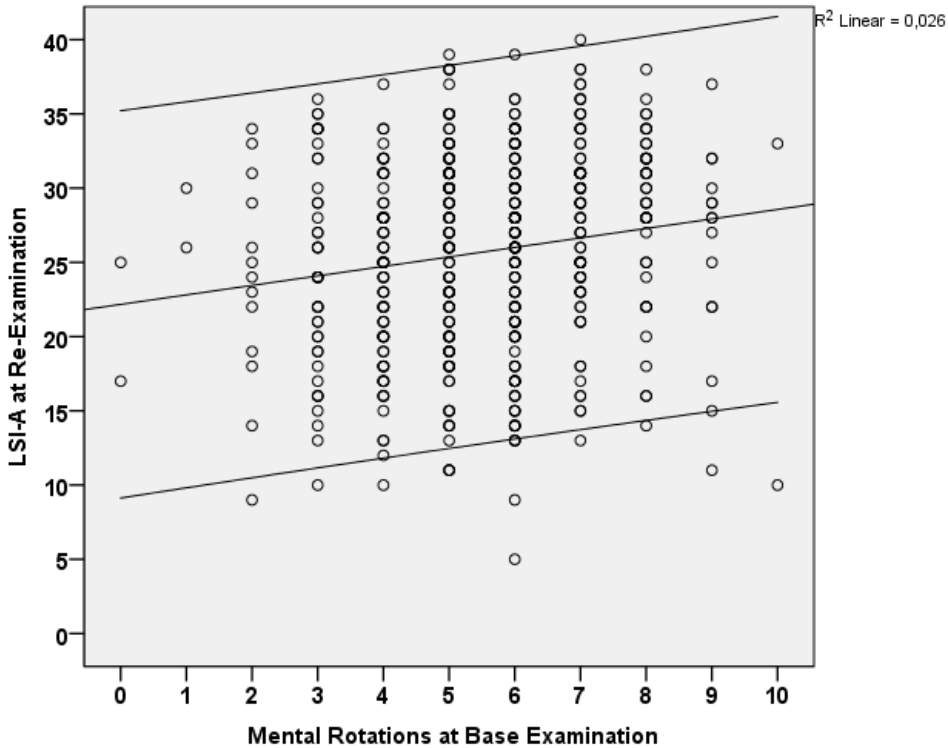

Figure 10. *Scatterplot showing association between LSI-A and mental rotations*

Multiple regression analyses were carried out for each cognitive domain separately with LSI-A at re-examination as dependent variable (Table 11). Each model was adjusted stepwise for sex, age, education, functional capacity and depressive mood. Processing speed and spatial ability remained associated with LSI-A after adjustment, with B=0.118, p=0.020 for processing speed and B=0.453, p=0.014 for spatial ability.

Table 11. *Linear regression analyses with LSI-A at re-examination as dependent variable, and cognitive domains at base-line as independent variables. Further regressions showing association between cognitive domain and LSI-A adjusted for sex, age, education, ADL and CPRS. (CPRS in two groups, 0-6 and 7-34, independent/dependent in ADL, age in groups 78-84 and 87-93. B-coefficient with p-value in parenthesis.*

LSI-A	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Executive abilities	0.045 (0.010)	0.045 (0.010)	0.041 (0.018)	0.034 (0.115)	0.018 (0.349)	0.014 (0.444)
Processing speed	0.165 (0.001)	0.177 (<0.001)	0.161 (0.001)	0.139 (0.006)	0.117 (0.020)	0.118 (0.020)
Episodic memory	0.302 (0.032)	0.345 (0.014)	0.303 (0.031)	0.252 (0.078)	0.194 (0.172)	0.188 (0.185)
Semantic memory	0.038 (0.445)	0.044 (0.368)	0.033 (0.502)	-0.008 (0.882)	-0.033 (0.518)	-0.056 (0.289)
Spatial abilities	0.639 (<0.001)	0.569 (0.002)	0.554 (0.002)	0.498 (0.007)	0.505 (0.006)	0.453 (0.014)
Working memory	0.107 (0.269)	0.112 (0.242)	0.091 (0.342)	0.027 (0.782)	-0.018 (0.856)	-0.016 (0.872)

Model 1: cognitive domain
Model 2: cognitive domain+sex
Model 3: cognitive domain+sex+age
Model 4: cognitive domain+sex+age+education
Model 5: cognitive domain+sex+age+education+ADL
Model 6: cognitive domain+sex+age+education+ADL+CPRS

Table 12. Attrition analysis

Comparison between the 681 participants that came to reexamination and those 572 that didn't come back concerning LSI, age, sex, marital status, education, number of symptoms, depressive mood, locus of control functional ability and cognition. Differences in means tested with Students' t-test, difference in proportions tested with Chi2 test.

	Reexamined (SD)	**Dropout (SD)**	**p-value**
LSI-A	25.9 (6.6)	22.8 (7.7)	<0.001
Age	83.0 (4.4)	85.4 (4.8)	<0.001
Men/women (%)	38.7/61.3	36.2/63.8	0.365
Married/single (%)	39.1/59.4	32.4/ 67.6	0.010
Education low/high (%)	64/34	60.3/ 39.7	<0.001
Number of symptoms	11.8 (6.3)	13.3 (7.1)	<0.001
Depressive mood by CPRS	3.5 (4.6)	4.6 (5.6)	0.001
Locus of control, internal	19.5 (4.0)	17.1 (4.2)	<0.001
Locus of control, power	21.1 (4.3)	14.5 (4.0)	<0.001
MMSE	25.9 (3.1)	24.6 (4.4)	<0.001
ADL-scale	0.6 (0-8)	1.5 (range 0-8)	<0.001
Executive abilities	56.5	49.0	<0.001
Processing speed	18.0	15.7	<0.001
Episodic memory	5.8	5.0	<0.001
Semantic memory	19.1	17.2	<0.001
Spatial abilities	5.5	5.4	0.42
Working memory	5.0	4.3	0.001

DISCUSSION

Main findings

In this thesis we found that age, marital status, number of symptoms, depressive mood, health locus of control, functional ability and cognitive domains processing speed and spatial abilities predicted LS three years later in the oldest-old.
It seems as with higher age, as the balance between gains and losses become more negative, successfully applying the SOC strategies that Baltes and Baltes described becomes harder. The findings of the studies will be discussed in the context of the SOC-strategy.

Discussion of methodology

Internal validity

Internal validity reflects the extent to which a conclusion drawn from a study is accurate and the extent to which the independent variables are the actual cause of change in the dependent variable. A number of variables or circumstances uncontrolled for may yield additional or alternative explanations for effects found and for the magnitude of these effects. Internal validity, therefore, is a matter of degree rather than either-or. There are different kinds of threats to internal validity, some of which will be discussed here.

Confounding
A confounder is a variable in a statistical model that correlates (positively or negatively) with the dependent or the independent variable, thus weakening or strengthening the true relationship. For an example, the inclusion of depressive mood as a confounder in the regression models increases internal validity, since depression is thought to be a frequent and underdiagnosed condition in the elderly population (Gottfries and Carlsson, 2001), and is known to interfere with LS as well as several of the independent variables. This might thus have confounded the associations between for example functional ability or cognition and LS.
In this thesis, confounding effects have been taken into account through the use of multiple regression models and stratification methods (study I and IV). Confounders included in the regression models were chosen after searching through the literature on LS and related concepts. Exploring associations between LS and functional ability in paper III, we included well known aspects of impaired functional ability like economical situation, walking aids, help from relatives or society and part-taking in activities. In paper IV, studying LS and cognition, stroke, dementia, depressive mood, education functional capacity and age; factors known to influence cognition were included as confounders.

The LS-area is complex as it involves a multitude of medical, social, psychological and financial areas to name a few. In spite of the steps taken to reduce confounding, there are of course variables likely to affect LS that are not included in this thesis. In the studies, about 30% of variance in LS is explained, meaning other variables explain about 70% of variance in LS. Examples of variables not included are

personality (e.g. Costa, 1987; Berg et al, 2009) and heritability (Mrozcek and Spiro, 2005), two factors that have been shown to explain much variability in LS. Neither was Antonovskys' sense of coherence (1987) included; the notion that life is comprehensible, manageable and meaningful – also shown to affect psychological well-being.

Another reason for not being able to explain more variance could be that our instruments are "blunt". If we could capture finer aspects of for example functional ability than ADL can assess, we could perhaps explain more variance. This will be discussed further below.

Dubious temporal relations

This addresses the question of whether the independent variable caused change in the dependent, or if the opposite is true. In literature, there are two different perspectives of LS labelled "top-down" or "bottom-up" theories. The first states that life events cause subjective well-being to deviate only temporarily from a rather stable state that is unique to each individual and related to other stable personality characteristics and psychological traits (Siedlecki, 2008). Bottom-up theories emphasize life circumstances as more decisive for LS. As for this thesis, it is possible that LS would be found to predict depressive mood, number of symptoms and age, just to name a few of independent variables used. LSI-A would then have had to be included as independent variable and ADL or the symptom-scale as dependent variable.

The validity of the medical diagnoses can be considered good as they are based on medical records as well as the patients' own statement. However, the diagnoses included in the study say nothing about when the person received the diagnosis; this may explain why they did not show significant relations to LS. The individual could have had a fracture or non-disseminated cancer years ago that healed well. They might also have a diagnosis that is well treated (i.e. heart failure) and therefore non-symptomatic.

5.4% of the study population had a diagnosis of dementia and thus took part in the examination with the help of others. As long as the respondent could understand instructions he/she was asked to fill in LSI-A which 55% did. Analysis of LSI-A including and excluding people with diagnosis of dementia showed no difference. 92% of those with dementia diagnosis completed Tibblins' symptom questionnaire. Cognitive tests were also carried out even in cases with diagnosis of dementia. Questionnaires like ADL were filled in with the help of proxy.

We chose looking at one point in time and another point three years later. This could potentially lower the explanatory power, but when comparing variables from base- and re-examination, there was very little change during three years.

Only in the third study we used change in LSI-A; comparing it to change in ADL. When choosing whether to use delta-values or score at re-examination the presence of floor and ceiling effects can be considered. Those very low in LS at baseline may not sink further even if things change for the worse. A ceiling effect on the other

hand means that those that are very satisfied with their lives might not increase further. Those unchanged could be either high or low in LS.

ADL-capacity can be measured in three different ways: the subject can report his/her functional capacity by themselves, an interviewer can write down the subjects' answers, or an observer can ask the subject to actually perform; show the observer that he/she is able to carry out the tasks on each step. In our study, ADL is self-reported, but in cases where the examining nurse noticed that the respondent had checked an ADL-level that was not in accordance with the actual functional ability, she changed the answer. This makes the ADL-answers more trustworthy than if it had been only the questionnaire.
We did not see significant associations between ADL and LS in paper I when respondents were categorized as "independent", dependent in at least one I-ADL but independent in p-ADL, or dependent in at least one p-ADL but a tendency to maintain LS when ADL was unchanged can be seen in table 8. In the third work when the ADL-scale; a finer measure was used, associations were significant. Also, in the first article we studied associations between ADL as it was in the base-examination, while in the third we looked at change in ADL during the three years.

Construct validity

Construct validity is the extent to which what was meant to be measured was actually measured. This can be evaluated by calculating correlations to other well-established nearby concepts. The instruments used in the studies (such as LSI-A, ADL, MMSE and CPRS) are standardized and internationally well-known instruments that have shown good reliability in previous validations. (Hulter and Åsberg, 1988, Montgomery and Åsberg, 1979, Folstein et al., 1975, Lobello 2004)

However, a recent Swedish study (Fagerström et al, 2012) questioned the factorial validity of the LSI-A. Authors tested different versions of the LSI-A in a large elderly Swedish population. They found that Neugartens' original five factor scale did not fit the data. Rather, later versions (Hoyt and Creech, 1983; Liang, 1984) with three factors showed a better fit. Factors found in Hoyts' study were called satisfaction with past and present life plus optimism for the future. Furthermore, Fagerström et al found evidence for lack of invariance comparing groups with lower/higher scores on depressive mood, as well as for groups that were independent/dependent in functional capacity. This indicates that LS takes on different meanings for a depressed or functionally impaired individual compared to a person that does not suffer from impairment in these areas. Nevertheless, we see clear differences in LSI-A between respondents that are independent vs dependent in ADL (mean 26.0 compared to 23.7; data not shown), and that change in ADL means change in LSI-A (study III). We also see differences between groups low and high in depressive mood (LSI-A score 25.1 compared to 22.2, see paper III). These differences are larger than differences noted between married/single or the younger group compared to the older. This implies that the LSI-A instrument is able to differentiate between these groups.

It is possible that the results would have been different if we had chosen to work with the different factors of the instrument. Figure 6 shows that for those that came to re-examination and fulfilled the LSI-A, there are those that report an impairment of LS after three years, but there are also quite a few that report a better LS in the re-examination. This indicates that the LSI-A as a whole instrument, is influenced by life events.

In our first study we use LSI-A as dichotomized by the highest tertile versus the two lower. In the other articles we use LSI-A as a running scale. We chose the latter method as an impartial way of approaching a material in an explorative way to see if there were differences between polar groups. The risk with this method is to loose information, but comparing results to those in the third article, they are very much in line with study I. Thus, we conclude that not much information has been lost.
We also didn't draw any conclusions from those variables that didn't show significant associations with LSI-A, such as social network.

Statistical conclusion validity

Statistical conclusion validity refers to how the risk of type I and type II errors has been dealt with. Type I error means to find a difference that in reality doesn't exist. Significance level was set to $p<0.05$ in papers I-IV. Type II error is the conclusion that there are no differences between examined variables when there in fact are. It is related to power. With a study population of 681 individuals, we had the power to discriminate mean differences in LSI-A larger than 1.0 points. To reduce risk of type II error, significance level was set to $p<0.2$ for inclusion in the regressionmodel in study III.

To reduce the risk of mass-significance, the symptoms in paper II as well as the cognitive tests in paper IV were reduced into pre-defined symptom- and cognitive domains (Tibblin, 1990; Lezak, 2004).

External validity

External validity describes the extent to which the results in the study can be generalized to other populations, in this case the extent to which our study-population represents the general oldest-old population. Measures aiming at increasing the internal validity may limit the external validity of the findings. Our study-population comprised a rather large randomly selected sample, selected using the Population Registry to increase generalization to a general old-old population. Randomisation minimizes the risk of selection bias. The five included municipalities were chosen so that the study population would represent the general population in Skåne as to rural/urban living. Proportions were weighted so that more participants came from cities. Citizens from all areas of the larger cities were included to avoid bias due to education and income. To reduce selection bias, no exclusion was made for subjects living in residential care or homes for elderly. Home visits were offered and carried out in about 20% of the cases for those unable to get to the research-clinic. Since the examination is rather extensive, subjects were offered to split it up in three to four different sessions. Help to fill in the

questionnaires was offered to people with difficulties reading or writing. Identical standardized protocols were used in base- and re-examination. The GÅS-study is a very extensive examination, something that is both a weakness and strength. The extensiveness is likely to cause drop-out among people lacking patience and motivation to proceed. On the other hand the extensiveness gives a broad picture of the oldest-old population that is rare.
Each participator was examined by a physician, a registered nurse trained in research and a test leader with a bachelor in behavioural science. The nurse and the test leader were the same persons at base-line and in re-examination.

Attrition. The initial participation rate was 53.5% which is similar to other studies on the oldest-old population (Borglin, 2004). 314 died during the three years between examinations and eight moved out of the area. Of those still alive, 73% participated in the re-examination. In the attrition analysis (tab 12) it is clear that participants that were older and had lower scores on LSI-A, more depressive symptoms, worse functional ability, higher number of symptoms and so on, were those that didn't come back to re-examination. Therefore generalisation to the general population must be done with caution as results may represent a "happier and healthier" population than the general. It is also possible that associations seen in papers I-IV would be stronger if those participants had continued in the study.
Internal attrition was minimized by contacting respondents again if some part of the questionnaire was not properly filled in. Still 109 (15.9%) individuals did not fill in the LSI-A questionnaire at re-examination. Those individuals had lower LSI-A scores at baseline; 22.6 compared to 26.4 ($p<0.001$).

Reliability

Reliability means reproducibility; to what extent results from one measurement would be the same if repeated. The validity of a test cannot exceed its' reliability. There are different aspects of reliability:
Internal consistency refers to whether the different parts of a test measure the same concept. A way to assess this is the split-half method in which the items are split into two halves and correlations between the halves are calculated. Another way is to calculate Cronbachs' alpha which is a general correlation measure between all items in an instrument or a measure of all split-halves carried out at once. Cronbach's alpha reliability for internal consistency was established by Neugarten (1961). In our material Cronbachs' alpha for LSI-A was 0.78. Cronbachs' alpha between 0.8-0.9 is considered good, and 0.7-0.8 acceptable, while values below 0.6 are considered poor (George and Mallery, 2003). Wallace and Wheeler (2002) conducted a metaanalysis of the LSI-A to examine generalizability. They used data from 34 studies and found the instrument to be reliable independent of sex, sample size, language of administration or mean age.

As for the ADL-scale, Sonn and Hulter-Åsberg tested its' reliability and estimated it to KR20=0.9 using Kuder Richardssons' formula. KR20 is analogous to Cronbachs' alpha and a value above 0.65 is considered acceptable. In our study, Cronbachs' alpha for the ADL-scale at baseline was 0.84.

Discussion of results

Life satisfaction

Neugartens' LSI-A was constructed to reflect five underlying domains (Neugarten et al, 1961). Of these, two (zest and mood tone) reflects the respondents' current life situation and three (congruence, resolution/ fortitude and self concept) reflects the life history and wholeness of life (Fagerström et al, 2012). Lyyra et al (2006) showed that low satisfaction with present life predicts mortality in the oldest-old. Berg et al (2011) also found declining LS to precede death, a decline independent of health variables. LS instruments will perhaps gain their place in clinical practice in the future, since they might have a sensitivity that goes beyond traditional medical assessment methods. Integrating psychological and medical perspectives to a higher degree in the care of the oldest-old could be a gain for patients as well as physicians. For example, Berg (2011) describes that LoC and neuroticism moderate the relation between burden of disease and self-rated health and LS in the oldest-old.

A Turkish study using LSI-A to evaluate LS in a population aged 79 and above found mean LSI-A values of about 25, similar to our results. (Subasi and Hayran, 2005) Writers comment that in Turkey it is generally considered that if an elderly is living in a "home" it is because he/she has no family that is able to take care of them. Therefore it is slightly surprising that the level of LSI-A is as high as in our population that is randomly drawn from the general elderly population.
Bowling and Grundy (1997) used LSI-A in their study on functional capacity and LS. Comparing three different groups, the group most comparable to our study population consisted of 252 subjects aged 85 and above. Here LS was categorized into three groups depending on LSI-A score. Their scale ranged from 0-20; 0-6 was classified as having a poor LS, 7-13 "medium" and 14-20 "high". 39% of their population had poor LS, 30% medium and 31% high. In our material the corresponding numbers were 25% poor, 40% medium and 26% high.

Based on factors shown to influence LS in the oldest-old in the literature, we identified several factors affecting LS in our study-population; the number of symptoms, aspects of health locus of control, depressive mood, reduced functional ability and the cognitive domains processing speed and spatial abilities.
Figure 6 shows that quite a few report better LS after three years. Some of these have improved in functional ability (fig 9), others might have had a reduction of symptoms. Bowling (2011) found that many older people define LS as being able to continue doing the things they have always done. A greater appreciation of being able to function in daily life could thus also be part of the explanation why some report higher LS three years later.
Below, LS will be discussed in relation to the different covariates included in the thesis that were based on findings in the literature covering this area.

Age

Opinions on whether LS and related concepts are constant or not depending on age are diverse. Blanchflower and Oswald (2008) conducted a study including several hundred thousand participators across 72 countries. They found happiness or LS to reach its minimum in middle age; that is between ages 45-55 in a very similar pattern across countries. Though no specific focus was placed on the elderly, adults of all ages were included, even those above 85. Factors controlled for were such as marital status, income and also cohort differences. Health variables were not included. Although the great pattern was clear and indicative of raising levels of happiness with age, they did see a tendency for a flattening and even a turn of the curve with approaching death. Suggested reasons for the low point in middle age were that in this age individuals face the fact that dreams and aspirations of their youth may not come to pass, and after adaption to this, happiness rises again. Another thought was that with higher age, it becomes easier to see the positive aspects of life circumstances, perhaps in comparison to people your own age who passed away.

Mrozek and Spiro (2005) conducted a large longitudinal study of male American veterans, but found results pointing in an opposite direction. Here, LS peaked at about age 65 and then declined. No women were included in the study and LS was measured by a shorter version of the LSI-A scale. Nevertheless, these opposite results might seem a bit puzzling. Interestingly though, these studies both found that LS declines steeper with proximity to death, a finding also supported by Berg et al (2011).

In our studies, results point to that it is not higher age by itself, but rather the increasing burden of symptoms, impaired ADL or other factors associated to the aging process that yields impaired LS. Our findings thus tend to support Costa et al (1987) that meant that LS is mainly dependent on personality traits, and those are relatively stable throughout life. In this thesis higher age was associated with worse LS, yet explained only 1-2% of variance in LS (tables 3 and 9). When split in two agegroups, there was a tendency for the older group to score lower on the LSI-A, but the difference was not significant on the 5% level.

We used chronological age as time-measure. As mentioned, it has been suggested that proximity to death yields more information (Berg, 2011). Adjusting for this might thus have weakened the association between chronological age and LS in our studies further.

The participants in our studies were born between 1908 and 1923. Our findings are probably coloured by conditions and events experienced uniquely by these cohorts. They would for example have been teenagers or young adults during World War II. It would be an interesting topic for further research to compare levels of LS in our study population with cohorts born in the 30's and 40's. Blanchflower and Oswald (2008) found American cohorts to become progressively less happy while European cohorts were relatively unchanged. Cohorts examined in their study were defined according to birth years from year 1900-1909, 1910-1919 and so on. The cohorts were followed regularly between years 1972 and 2006.

Gender

In a metanalysis, Pinquart and Sorensen (2001) found that women report lower SWB on nearly all measures although gender differences decrease when controlling for factors such as widowhood, health and SES. This could probably be described as the main trend in the literature, although some studies indicate that there aren't any differences. Fiske et al (2003) found more depressive symptoms among elderly women than men and Baltes and Smith (2003) found a higher risk for unsuccessful aging in women.

In our studies, there is a clear difference in LS between genders on a univariate level, but significance is lost after adjustment (Tables 1, 3 and 9). This probably means that the differences are accounted for by the fact that women have more health-related problems, are more likely to become widowed and generally have worse economic conditions than men (Berg, 2006). In Sweden equality between the sexes has been an important question for many years and comparing globally, Swedish women now have equal opportunities in many fields. In the cohorts of our study, however, the differences are likely to be bigger. One would thus expect smaller differences in more recent cohorts, but surprisingly, Pinquart and Sorensen (2001), found that differences in SWB between the sexes is increasing rather than decreasing. This would be an interesting topic for further research as the GÅS-project continues to follow younger cohorts.

Symptoms

The single item that explained most variance (13.6%) in LS in this thesis was the number of symptoms (fig 8). The self-reporting of symptoms is obviously related to "subjective health", which has been shown to be a strong predictor of mortality as well as LS (Diener, 1984, Hillerås et al 2001). In the Tibblin symptom scale, respondents are asked for experienced symptoms, and possible underlying causes or conditions are not investigated. The symptoms could be caused by a multitude of physical conditions, and though not dealt with in this thesis, it also deserves to be mentioned that many symptoms in this agegroup are probably *caused* by medical treatments. Very few drugs have been tested in this population in clinical trials and the knowledge of reactions to multiple drug use is even more scarse. Furthermore it is common for an individual if higher age to have encountered several different medical specialists that have initiated different treatments; the effects of combinations of which are unknown.

The reporting of symptoms includes perception and encoding of a sensation by the responder. This process differs markedly between individuals and cultures. We show that a higher number of symptoms is associated with lower LS. The interpretation of this can be twofold: the person reporting more symptoms could have worse health and therefore lower LS. The reporting of more symptoms could also be an expression of personality traits underlying the lower LS, or a combination of both. Rennemark and Hagberg (1999) found a strong relation between sense of coherence and reporting symptoms, further underlining that the reporting of symptoms is not merely based on physical sensations. Pennebaker et al (1982) found that a person who reports any one symptom is also more likely to report other symptoms. Also, people with stronger internal LoC report fewer

symptoms than those high in LoC chance. Pennebaker found that "high symptom reporters" are anxious, have low self-esteem and come from a lower socioeconomic background. That is, there is a similarity between predictors of lower LS and predictors of reporting more symptoms.
The most common symptom in our study population was general fatigue, reported by 67.7% (Table 4). Fatigue was also the single symptom with the highest correlation to LSI-A. Our findings thus confirm the findings of Borglin et al (2004). Fatigue is a state or symptom that can be caused by multiple underlying conditions, but can easily be bypassed by clinicians and has received little attention in literature. The geriatric population is well known for its' unspecific presentation of symptoms; fatigue could represent a multitude of underlying conditions. Vass et al (2002) showed fatigue to be a strong predictor of functional decline. It is a state that probably deserves more attention in clinical practice given its' association to LS as well as functional capacity. The association between domains of symptoms as well as a single symptom such as fatigue, can be interpreted in light of Baltes' SOC-model. Mechanisms described here work together to create a positive feedback loop generating LS. Symptoms such as fatigue or depressive mood, interferes with these strategies and could instead initiate a negative feedback loop as described by Verbrugge and Jette (1994) in their model of the disablement process. Fatigue would then lead to less activity, which would yield less muscular strength and with time, reduced functional capacity and reduced LS.

The fact that the medical diagnoses included in paper I did not show a significant association to LS might be interpreted as events that happened a long time ago such as a fracture that healed well. It could also represent conditions well treated, for example properly medicated heart failure. The consequences of a medical condition, expressed as symptoms or impaired ADL, rather than the condition in itself, seems to be what matters for LS. A Swedish study (Stålbrand et al, 2007) that followed about 200 individuals from age 80 to age 95, compared subjects with a high burden of symptoms but with few or no diagnoses, to subjects with two or more medical diagnoses and found similar predictive values for mortality.

An interesting finding from study II is that some of the somatic symptom-groups, such as cardiopulmonary and urinary, did *not* have a significant bearing on LS three years later, while psychiatric symptoms did. Perhaps this reflects that it is easier to seek and receive medical help and aids for somatic conditions than psychiatric; the cough, breathlessness or incontinence may have been taken care of three years later but not the psychiatric symptoms.
In the regression model of study II, change by one score in severity of tensive symptoms or symptoms from the GI-tract means a change in LSI-A with about 1.5 steps. Theoretically, this means that reducing severity of symptoms in three groups can move an individual from the median to belonging to the highest quartile of LS.
Not all variables included in this thesis are reachable for interventions, but the reduction of symptoms is certainly an area where physicians and other health care staff can be active and alert when striving to enhance LS in the oldest-old.

Functional ability

Considerable efforts have been made to try to unsolve the sense of finality to the formally established expressions "disabled" or "handicapped". When WHO lanced the ICF-model (International Classification of Functioning, Disability and Health, WHO, 2001), it was an endeavour to stress an individuals' levels of health and functioning rather than disability. In this way it would be easier to assess needs to optimize functioning in specific areas such as participation or activities. All over the world, reduced functional ability (assessed by ADL or other measures), is being postponed to later decades of life (Crews and Zavotka, 2006). The practical implications of models like ICF are of course of interest when studying the oldest-old, the group in society with the highest risk of reduced functional ability. The ICF-model has also been modified with LS as final outcome measure (Ekstrom et al, 2008).

Thirty percent of our study population reported that their functional ability was impaired after three years. The greatest decline was, as expected, found in the oldest individuals, those aged between 87 and 93 at baseline. 51 % of those were impaired in their functional ability after three years. From the attrition analysis we can conclude that this number probably is even higher in the general oldest-old population (table 12).

Impairments were mostly in the I-ADL items like cleaning, grocery shopping and cooking. The associations to LS would probably be stronger if P-ADL had been more affected since P-ADL deficiency would be more difficult to compensate for and affect personal integrity to a higher degree. It is also noteworthy that for the study population as a whole, 54% reported unchanged ADL-status (table 7), and 6.5% even reported improved functional ability after three years. The main part of those had improved in I-ADL items.

Comparing mean values, those aged 87-93 with impaired ADL had lower LS than those not impaired. Refining the examination however, there was a difference in how change in ADL affected the groups (fig 8 and 9). Those that at re-examination were between 90-98 years old were not as affected by change in ADL as their younger counterparts. This could be a true correlation, but we also notice in the attrition analysis that the very oldest as well as those with lower FA and lower LS are those dropping out. It could also be caused by floor-effects – the satisfaction with life was low at base-examination and doesn't decline more even when functional ability declines. Yet another explanation could be that in these ages, there is a higher readiness to accept a certain degree of dependence and need of assistance. The findings need to be confirmed before drawing firm conclusions, but if the association is weaker among the very oldest, that should probably be taken into account when planning rehabilitation efforts, at least if the aim of rehabilitation is to enhance LS.

In the setting of geriatric patients and impaired functional ability, the phenomenon of unspecific presentation of symptoms should be pointed out again. For example, it has been suggested that treating depressive symptoms in the oldest-old might reduce functional decline (Palmore and Burchett, 1997). This places high demands on clinicians striving to aid in the maintenance of LS in this group.

Studies have indicated that the association between LS and burden of disease as well as between LS and reduced functional ability is mediated by personality factors such as extraversion and self-esteem (Berg, 2011, Borg, 2008). These factors were not included in our study even if the health locus of control scales partly reflects personality.

The overall conclusion from paper III is that restrictions in functional ability are associated to lower LS in the oldest-old. This of course raises the question of how society and the healthcare system can work efficiently to prevent and/or rehabilitate functional decline in the oldest-old. And if functional ability can't be restored – what different kinds of compensation are efficient in the oldest-old? A relatively new field of research is emerging around the concept Universal Design (Crews and Zavotka, 2006). This is the endeavour to construct housing, furnishing, household details and so on, that are constructed to be usable and accessible to individuals with a wide range of physical and cognitive abilities. An example mentioned in this review article (Crews and Zavotka, 2006), is that many size standards for kitchens or bathrooms were determined based on anthropological measures of young, male, American military staff. The point here is that some aspects of functional abilities in the oldest-old might improve rather dramatically with adapted environments. This is probably an area worth financial investments, given the associations between functional ability and LS and the expected increase of this segment of the population. Here, again, the SOC-model can be applied by optimizing available functional ability and compensating for that which has been lost.

Cognitive abilities

In study (IV) we found an association between cognitive domains processing speed and spatial ability (both related to fluid intelligence) and LS in the oldest-old, although other factors explain more variance in LS. Explanations for the association could be of two kinds – individual and contextual. Siedlecki et al (2008) hypothesised that Gf would not influence LS in this age-group since the oldest-old are no longer involved in work-life, meaning they face less new situations. However, though not professionally active, the oldest-old can be said to meet more new situations than at most ages; meaning functional decline, losses of loved ones and so forth. Perhaps the association between Gf and LS is explained in better prerequisites to handle age related changes in those with higher Gf. On the contextual level, Gf might be required to stay active and involved in todays' society with its' increasing technological development and demands (Calvert et al, 2009). Failing compentencies combined with demands from society that remain the same or even increase, results in maladaptive behaviour as described in the docility hypothesis by Lawton and Nahemow (1993).

Spatial abilities have been associated with creativity in many different areas (Lohman, 1996). Spatial ability is thought to contribute to a richer understanding of spoken and written language through the ability to create visuospatial images associated to what is being said or read. Mentally rotating a three dimensional

figure place high demands on working memory and visuo-spatial tests have been shown to correlate with general Gf.
Processing speed has been defined as "the ability to automatically and fluently perform relatively easy or over-learned elementary cognitive tasks, especially when high mental efficiency (i.e., attention and focused concentration) is required" (McGrew, 2009). In a recent, large intervention study (Wolinsky et al, 2009), training of processing speed was shown to reduce the risk of clinically relevant increases in depressive symptoms. Other domains tested but not found to affect depressive symptoms were memory and reasoning. The authors discuss two possible different pathways in which the training would be protective. First, processing speed training has been shown to affect functional ability, HRQoL and driving behaviour. Improvements in these areas would then mediate the effect on depressive symptoms. Processing speed has also been shown to have a broader pattern of regional brain activation than other cognitive domains such as memory or reasoning (Wolinsky, 2009). The training could thus have a direct effect on brain functions related to mood. The participants that received training in processing speed were 30% less likely to experience depressive symptoms than the control group. This opens up interesting, non-pharmaceutical possibilities for enhancement of LS in older populations and sheds light over the findings in study IV.
As pictured in figures 9 and 10, the association between processing speed and spatial abilities and LS seems to be operating in the whole distribution of individuals, not just for those that score in the lower or higher part areas of each domain.

Depressive mood

We found a strong influence by depressive mood on LS, and that the prevalence of depressive or tensive symptoms is high in the oldest-old (Table 4). In study II, 39% of women between 87 and 93 years, and 34 % of women aged between 78 and 84 years, claimed to have had severe depressive symptoms during the last three months. The percentage was lower for men, but 60% of the men between 87 and 93 years claimed to have had mild to moderate depressive symptoms during the last three months. Results from the attrition analysis show that individuals with higher scores on Tibblins' symptom scale as well as CPRS were those that dropped out of the study. The prevalence of depressive symptoms can thus be assumed to be even higher in the general old-old population.
Studies on younger objects, such as Tibblin (1990b) and Al-Windi (1998), have indicated that depressive symptoms decrease with higher age, however the oldest participants in those studies were 65-70 years. Demura and Sato (2003) saw that depressive symptoms increase in the old-old rather than in the young-old. Skoog (2011) proposed in a review article that the prevalence of depressive symptoms might have its' highest prevalence in ages 55 through 65, whereafter it is lower and then increases again after age 75. Neither Tibblins' symptom scale nor CPRS are sufficient to diagnose the clinical diagnosis depression according to the DSM-system. Clinical diagnosis requires an objective assessment by a professional and symptoms are supposed to have lasted at least two weeks. Gottfries and Karlsson

(2001) found the prevalence of the clinical condition depression to be 12-15 % in a population above age 65.

In study I, CPRS correlation to LSI-A was calculated to r=-0.274, which means that CPRS explained about 7.5% of variation in LSI-A (table 2). In the adjusted model (Table 3), depressive mood remained significantly associated to LS. As stated, "depression interferes with nearly all determinants of successful aging" (Jeste et al, 2010).

The CPRS-scale gives a picture of how the respondent has been feeling during the last three days. How the person assesses his/her mood is of course coloured by personality and there may be considerable discrepancy between a clinicians' assessment and the patients own experience. An interesting topic for future research would be to relate the CPRS-scores to the clinical diagnosis depression and medically treat those fulfilling the criteria to see how this affects evaluations of LS. Depressive mood, with its' lack of energy and low-spiritedness, would naturally hinder the elderly individual from successfully engaging in Baltes' SOC-strategies to adapt to the changes that come with age.
The clinical condition depression is thought to be underdiagnosed and thus undertreated, especially in the oldest-old. This could be due to atypical presentation that may make the condition hard to recognize, both for the professional and the patient. Elderly subjects with depression tend to emphasise somatic complaints like pain or fatigue, and since they often have somatic diseases the diagnostics become even harder. There may also be a misinterpretation that the depressive symptoms are part of the normal aging process, and the elderly individual may be more ashamed to admit to depressive symptoms than a younger person. Including depressive mood rather that clinical diagnosis depression must therefore be considered a strength in this thesis, since by including diagnoses we would have lost a number of individuals that suffer from depressive mood or depression but haven't sought a physician for it or received diagnosis.

Marital status

Being married is likely to provide social anchorage as well as social and intellectual stimulation. Being married or cohabiting was predictive of better LS in study I as well as study III, on a univariate level as well as after adjustment. Comparing LSI-A between married and single individuals (table 1), the difference is 2.6 points – a larger difference than found between the genders and between the age-groups. Our results thus support those of Diener et al (2000), who found being married to be associated to LS at all ages. Getting married and loosing a spouse are two things that have been shown to have a long–term impact on LS as opposed to many life events that affect LS for only a few months (Suh et al, 1996). As for number of symptoms, marital status may reflect not only present relational status, but the ability to maintain a long-term relationship might be an expression of personality-traits that per se influence LS positively (Mastekaasa, 1992).

Health locus of control

LoC has been shown to influence LS, health, functional ability as well as the ability to use social support in both old and old-old people (Braumgart and Johansson, 2007; Femia et al, 1997; Berg et al, 2006). In this study, we have used a derivation of the LoC-scale with focus on control-beliefs of health (Walston and Walston, 1976). We found that internal and powerful others HLoC were significant factors in predicting LS after adjustment for confounders.

Internal LoC means that the individual believes that he himself has the major influence over his health; if he takes care of himself in a proper way, he can avoid disease and so on. In our thesis, there is a clear association between internal locus of control and higher LS. People with this viewpoint might also be more likely to apply selective optimisation with compensation in their everyday lives, and thus actively strive to maintain LS, a health outcome. (It should be noted that we have used the model of selection, optimisation and compensation as an aid for interpretation and discussion – we haven't attempted to measure the elements of the theory in an objective way.) Our results are in line with Landau and Litwin (2001), who found internal LoC to explain LS to a greater extent than factors such as social network.

LoC "power" was also associated with higher LS. LoC "power" means holding beliefs such as "the healthcare system and its' staff rule over my health", or, "as soon as I feel bad, I should contact the healthcare system". These are individuals of high trust in doctors and other healthcare staff. In attrition analysis it was noted that individuals that continued in the study scored much higher in LoC power than drop-outs. This is rather characteristic since this group is more likely to "do what the doctor says"; in this case participate in examinations. This group can probably also be expected to have better compliance to prescriptions and advice from medical staff; perhaps this is part of the explanation why this kind of control belief is associated to higher LSI-scores.

A recent Swedish study (Berg et al, 2011) showed that the association between LS and high burden of disease is mediated by LoC, so that disease-ridden individuals with high internal LoC have the same levels of LS as healthy individuals. This underlines the importance of integrating psychological perspectives and medical, clinical practice.

Socioeconomical status

Economical sufficiency was included in study I as well as III. In the univariate analyses, subjects reporting economical insufficiency had significantly lower LS. In the adjusted models however (Table 3), economical sufficiency was not significant on the 5% level, although very close in study III. Interpretations must therefore be made with great caution. The trend in our material is that SES does matter, but that there are other factors that carry a more decisive weight for LS in the oldest-old. About 2% in the study population answered "yes" to having had financial difficulties concerning expenses for food or paying the rent or other bills on time during the last 12 months. This number is comparable to the number for the whole Swedish population (SCB, 2006).

Pinquart and Sorensen (2001), found the degree of financial satisfaction among older adults to be high. They discussed that the ability to adjust needs to assets may grow with higher age. This could be yet another expression of applying Baltes' SOC-theory, this time in the economical sphere.
60% of the study population had no further education than elementary school (Table 1). Subjects with higher education scored significantly higher on LSI-A. In the adjusted model in study III, (Table 9), education remains significant after adjustment. Jeste et al (2010) also found a significant association between level of education and successful aging although correlations to factors such as depressive symptoms and self-rated health had a stronger influence.

The models

As an aid for interpretation of factors found to influence LS in the oldest-old, the framework of Baltes' model of selection, optimization and compensation (Baltes and Baltes, 1990) was used in this thesis (fig 3). The process of SOC becomes increasingly important in an old population as losses in biological, mental and social reserves increase and there are negative changes in the ratio between gains and losses. As mentioned above, the SOC model has mostly been applied in research on cognition but it has also been used in the setting of chronic disease (Gignac et al, 2002) and the three mechanisms of adaption has been shown useful in an elderly population facing disability and pain. Other theoretical models in use are the ICF-model (WHO, Geneva, 2002) and Lawtons' docility hypothesis (Lawton and Nahemow, 1993). However, these models don't have QoL, LS or other nearby concepts as primary outcome variables, as did Baltes when describing the SOC-model; a "prototypical strategy of successful aging"
The results in this thesis can be used as a foundation in the design of intervention studies when further establishing what factors, medical, social or financial, that can be affected when aiming at maintenance of LS in the oldest-old.

CONCLUSIONS

We conclude that there are factors that affect LS in the oldest-old that are in reach of medical or other kinds of interventions. In clinical practice, being aware of, and being able to recognize these factors might aid when striving to maintain high LS in the oldest-old.

- The reduction of symptoms in the oldest-old has the potential to enhance their LS. Controlling symptoms may at first glance seem an obvious target, but can easily be infringed by the desire to find the correct diagnosis and applying the correct treatment for it.

- The prevalence of symptoms in the oldest-old is high – only four persons, or 0.6% of the study population claimed to have had no symptoms at all during the three months that preceeded base examination.

- Some groups of symptoms affect LS to a higher degree than others. Symptoms of a depressive and tensive kind, as well as symptoms from the gastrointestinal tract and musculoskeletal symptoms should catch the attention of the healthcare professional.

- Thirty percent of the study population reported impaired functional ability in three years. Change in functional ability is related to change in the LSI-A index.

- Investing in the maintenance and/or restoration of functional capacity in the oldest-old and developing environments adapted to this age-group, has the potential to preserve or even increase the LS of the oldest-old.

- Cognitive abilities within the domains processing speed and spatial abilities affect LS to a minor degree.

- Assessing control beliefs might be helpful in identifying individuals at risk of low LS, as “internal” and “powerful others” locus of control seems to be protective against low LS.

The factors in that proved important for maintenance of LS in this thesis; burden of symptoms, functional capacity, being married/cohabiting, cognition and so on, are all factors that are challenged in this age-group. If the mechanisms that Baltes and Baltes describe in their SOC theory are to be applied in the oldest-old, active input is required from the individual himself. The role of society and the healthcare system will be to find medical, psychological and technological ways that provide support in the elderly individuals’ process of selecting, optimizing and compensating in the struggle to maintain a high life satisfaction.

FURTHER RESEARCH

There are several of the findings in this thesis that open up possibilities for intervention studies targeting LS in the oldest-old. Integrating the knowledge of the association between symptoms and LS in clinical practice would perhaps mean asking the patient about symptoms in a preestablished structured manner. This might help the clinician to put more focus on experienced symptoms as well as on medical diagnoses. Here is a possibility for an intervention study.

The strong negative association between depressive symptoms and LS in this thesis raises the possibility to study how the scorings of the CPRS-scale are related to the clinically defined diagnosis depression, and how many of those are actually being treated. An intervention study exploring how antidepressive medical treatment would affect LS in this group is another possibility for further research.

As for functional capacity, practical implementations encompass an organisation equipped to deliver effective rehabilitation to this age group.

The findings that processing speed and spatial abilities affect LS also open up for intervention studies, in which cognitive training would be performed in these domains and measures of LS would be compared between trained groups and controls.

To further explore contextual influence on LS, comparing cohorts in this thesis to later cohorts in the GÅS-study would be interesting to see if LS seems to be improving or declining across cohorts.

TILLFREDSSTÄLLELSE MED LIVET HOS DE ALLRA ÄLDSTA

Svensk populärvetenskaplig sammanfattning

Introduktion

Äldreforskningen har under de senaste decennierna breddat sitt perspektiv från fokus på sjukdom och funktionshinder till att inbegripa positiva utfall som livskvalitet och liknande begrepp. Medicinska såväl som kulturella och ekonomiska framsteg har lett till en optimism inom äldreforskningen med ökad livslängd och möjligheter att leva ett liv märkt av kvalitet högre upp i åldrarna. Den grupp som växer snabbast i samhället är den allra äldsta, de som är 80 år och äldre. Frågan är om denna grupp med sin höga prevalens av dysfunktion på olika områden och minskade resurser till återhämtning kan innefattas i ovan nämnda optimism. Det finns ett antal studier som ifrågasätter detta (Baltes och Smith 2003).

Selektion, optimering och kompensation

Som teoretisk ram för tolkningen av arbetet har vi använt de tyska psykologerna Baltes och Baltes teori (Baltes, 1990) om selektion, optimisering och kompensation. Denna kan tillämpas i vilken ålder som helst, men passar särskilt bra på äldre då man kan förvänta sig ökade förluster på viktiga områden i livet.
Selektion innebär att individen justerar sina förväntningar och väljer att fokusera på områden/domäner i livet som är särskilt viktiga för honom/henne. Optimisering innebär att individen (och samhället) engagerar sig i att maximera sin reservkapacitet och optimisera de områden som hon/han selekterat. Kompensering av såväl teknologisk som psykologisk art blir aktuell när individen förlorar olika förmågor.

Ett fint exempel som Baltes gärna använder för att illustrera sin teori handlar om pianisten Arthur Rubinstein och hur han hanterade sitt pianospel med stigande ålder. Han reducerade då sin repertoar och spelade färre stycken (selektion). Vidare övade han på just dessa stycken oftare (optimisering). För att kompensera en något långsammare finmotorik saktade han ner tempot i stycket innan en snabb passage för att ge intryck av att denna gick snabbare än den verkligen gjorde.

Begreppen och det goda livet

I litteraturen finns ett flertal besläktade begrepp. Det som använts här är livstillfreddställelse (LT), engelskans ”life satisfaction”. Andra begrepp är “livskvalitet”,”välbefinnande” och ”framgångsrikt åldrande”.

Bland dessa fyra begrepp är livskvalitet och framgångsrikt åldrande förmodligen de som liknar varandra mest. Båda innefattar såväl objektiva som subjektiva kriterier i sin strävan att beskriva ”det goda livet”. Välbefinnande och LT är subjektiva delar av det större konceptet livskvalitet.
Välbefinnande inkluderar inte yttre omständigheter utan fokuserar snarare på ett inre sinnestillstånd (Diener, 1984). Begreppet definieras efter två huvudkomponenter, en affektiv med såväl positiva som negativa affekter och en kognitiv; livstillfredsställelse. Livstillfredsställelse definieras som "en övergripande

kognitiv utvärdering av ens liv. Det kan påverkas av känslor, men är inte ett direkt mått på stämningsläget. Det är den enskildes subjektiva bedömning av sitt liv. Följaktligen blir LT det smalaste konceptet av de fyra, men helt tydliga gränser mellan begreppen är svåra att dra.

Neugarten

Den amerikanska psykologen Bernice Neugartens syfte med sitt instrument var att skapa ett mått på det goda åldrandet med individens egen utvärdering som utgångspunkt, relativt oberoende av andra psykologiska och sociala variabler.
Neugartens' livskvalitetskala (LSI-A) är multidimensionell och består av fem komponenter: "iver" (zest) gentemot apati, beslutsamhet och självstyrka; samstämmighet mellan önskade och uppnådda mål; positiv självuppfattning och stämningsläge.
Den inkluderar 20 frågor som ger mellan noll och två poäng var. På varje fråga kan deltagaren svara "håller inte med", tveksam", "håller med". Höga poäng indicerar alltså hög LT. Individen anses ha hög LT om han/hon: 1) finner glädje och tillfredsställelse i sina vardags- aktiviteter; 2) ser sitt liv som meningsfullt och accepterar och är någorlunda tillfreds med det liv som varit; 3) känner att han/hon i har uppnått de stora målen i sitt liv; 4) har en positiv självbild; och 5) har en fortsatt optimistisk attityd och optimistiskt stämningläge.

Syften

Delarbete I: Att identifiera faktorer som påverkar LT samt att beskriva hur LT är relaterat till de allra äldstas funktionsförmåga och hälsa, samt att se i vilken utsträckning de påverkar LT under en treårsuppföljning.

Delarbete II: Att beskriva frekvens och upplevd intensitetsgrad av symptom hos de allra äldsta och studera hur detta är relaterat till individernas LT.

Delarbete III: Att beskriva förändringen i vardaglig funktionsförmåga hos de allra äldsta under tre år och se om denna påverkade LT även efter att vi räknat med andra faktorer som påverkas då funktionsförmågan minskar.

Delarbete IV: Att undersöka om resultaten på 13 kognitiva test enskilt och sammanslagna i sex kognitiva domäner kunde prediktera LT tre år senare hos de allra äldsta.

Studiepopulation

Alla data är från Gott Åldrande i Skåne (GÅS-) studien. Ett slumpmässigt urval gjordes från folkbokföringsregistret i respektive åldersgrupp och inbjudan skickades ut. Vid basundersökningen deltog 1253 individer i åldrarna 78 till 93 år. Av dessa dog 314, 8 flyttade och 250 tackade nej till att fortsätta delta i studien.
Vår studiepopulation bestod således av 681 personer och omfattade sex åldersgrupper: 78, 81, 84, 87, 90 och 93 år. Ingående kommuner är Malmö, Eslöv, Hässleholm, Osby och Ystad. Deltagarna genomgick läkarundersökning, fyllde i frågeformulär, genomgick neuropsykologiska och funktionella tester. Samma

protokoll användes i båda undersökningarna som ägde rum antingen på geriatriska klinikens mottagning eller i deltagarens hem. Informerat samtycke erhölls från deltagaren och vid behov från släktingar. Samma studiepopulation har använts i alla delarbeten och kommer därför inte kommenteras för varje studie nedan.

I hela GÅS-materialet var deltagandet i basundersökningen ca 60%. De av de allra äldsta som sedan kom till återundersökningen var yngre, hade högre LT, färre symptom, var mindre nedstämda, hade högre funktionsförmåga och högre poäng på MMT än de som tackade nej och de som avled. De som fortsatte i studien hade även högre poäng på i stort sett alla kognitiva test. Det fanns däremot ingen skillnad mellan könen med avseende på bortfall.
109 individer som deltog i återundersökningen hade inte svarat på LSI-A. Dessa hade signifikant lägre LT i basundersökningen än de som fyllde i formuläret även vid återundersökningen.

Delarbete I

”What factors affect life satisfaction among the oldest-old?”

Åsa Enkvist, Henrik Ekström, Sölve Elmståhl

Syftet med den här studien var att undersöka faktorer som påverkar LT hos de allra äldsta. Vi ville studera ämnet ur ett brett perspektiv och inte bara inkludera medicinska utan även socioekonomiska och psykologiska faktorer.

I en statistisk modell visade vi att antalet symptom, civilstånd, locus of control, nedstämdhet och ålder kunde prediktera LT tre år senare. De medicinska diagnoser (stroke, demens, hjärtsvikt, fraktur och cancer) som fanns med i modellen föll inte ut som statistiskt viktiga prediktorer. Detta kan bero på att materialet indikerar att personen vid något tillfälle fått diagnosen, alltså inte hur aktuell sjukdomen är vid svarstillfället. Funktionsförmågan påverkade inte LT på ett tydligt sätt i regressionsmodellen, men i en separat analys såg vi att oberoende i ADL var förknippat med bibehållen LT.

Den kliniska tillämpningen av studien är att belysa de faktorer som påverkar de allra äldstas LT och på olika sätt är påverkbara, till exempel symptomkontroll, nedstämdhet och funktionsförmåga.

Delarbete II

”Life satisfaction and symptoms among the oldest-old: Results from the longitudinal population study Good Aging in Skåne”

Åsa Enkvist, Henrik Ekström, Sölve Elmståhl

Bakgrunden till studie II är att beskrivningar av symptomfrekvens och symptomintensitet och dess relation till LT hos de allra äldsta är oerhört få om det ens finns några.

Vi använde en modifierad version av Tibblins symptomskala som täcker 32 vanliga symptom. Denna relaterade vi till Neugartens LT-skala tre år senare. På frågan om de besvärades av ett specifikt symptom ombads deltagarna välja ett av fyra svarsalternativ: ”nej, inte alls”, ”ja, lite”, ”ja, ganska mycket” och ”ja, mycket”. Vi kunde konstatera att förekomsten av symptom i den här gruppen är mycket hög; till exempel hade 80% depressiva symptom i någon grad och 68% upplevde generell trötthet.
Tibblin har tidigare aggregerat symptomen i olika domäner. Dessas påverkan på LT testades i en statistisk modell. Fyra symptomgrupper hade speciellt hög påverkan på LT: depressiva – och spänningssymptom, smärta från muskler och leder samt symptom från mag- och tarmtrakten.
Studien syftar till att belysa hur viktig symptomkontroll är i den här åldersgruppen, då sådan har stor betydelse för bibehållen LT.

Delarbete III

“Associations between functional capacity and life satisfaction in the oldest-old - Results from the longitudinal population study Good Aging in Skåne”

Åsa Enkvist, Henrik Ekström, Sölve Elmståhl

Syftet med denna studie var att beskriva förändringen i funktionsförmåga hos de allra äldsta under tre år och undersöka hur denna påverkar LT.

Funktionsförmåga mättes med Hulter Åsbergs ”activities of daily life scale” (ADL-trappan) som i vår studie modifierades något och gick från 0 till 8 steg. Skalan täcker in aktiviteter som att handla, äta, sköta hygien osv. 0 poäng innebär att man är helt oberoende och 8 poäng innebär att man är beroende i allt. LT mättes med Neugartens LT-skala.

Populationen delades upp i två grupper baserat på ålder; 78-84 år och 87-93 år. I den äldsta gruppen försämrades 51% av deltagarna i sin funktionsförmåga på tre år. Gruppen som hade försämrats i ADL rapporterade också lägre LT (23.0 poäng jämfört med 26.4). Försämring i ADL hade en starkare negativ påverkan på den yngre gruppens ADL än den äldre gruppens. I en statistisk modell visades att försämrad funktionsförmåga var signifikant associerad till sämre LT – försämrades man ett steg i ADL-funktion så sjönk LT 1.5 skalsteg.

Den praktiska nyttan av studien är dels den beskrivande delen som kan användas för att beräkna vårdtyngd då den äldsta delen av befolkningen växer. Dels understryker den vikten av olika rehabiliteringsinsatser då dessa har potentialen att upprätthålla LT i den här gruppen.

Delarbete IV

"Associations between cognitive abilities and life satisfaction in the oldest-old. Results from the longitudinal population study Good Aging in Skåne"

Åsa Enkvist, Henrik Ekström, Sölve Elmståhl

Syftet var att studera om det finns samband mellan "kognition" eller intelligens och LT hos de allra äldsta. Studier av detta slag är få. I GÅS-studien ingår 13 så kallade neuropsykologiska test som utförs av en beteendevetare eller psykolog. Testen inkluderar till exempel "mentala rotationer", "stryka siffran fyra", "jämföra figurer" och ett synonym-test. Resultaten på dessa relaterades till Neugartens LT-skala tre år senare.

Sambandsanalyser genomfördes mellan vart och ett av de kognitiva testen i basundersökningen och LT i återbesöket. Dessa delades upp och gjordes separat för kön, ålder, utbildning, nedstämdhet och sjukdomstillstånd som stroke och demens för att se om den kognitiva förmågan i sig predikterade LT och inte skymdes av tillstånd eller egenskaper som i sig påverkar LT eller den kognitiva förmågan.
Testen lades sedan ihop till sex olika kognitiva domäner; exekutiva förmågor, processhastighet, episodiskt minne, semantiskt minne, spatial förmåga och arbetsminne.

Resultaten visade att efter justering för multipla faktorer kvarstod ett samband mellan kognitiva förmågor inom domänerna processhastighet och spatial förmåga, och LT tre år senare. Båda dessa domäner relaterar till flytande intelligens, en typ av intelligens som man vet sjunker med högre ålder. Fynden blir intressanta i ljuset av andra studier som visat att flytande intelligens kan tränas upp även högt upp i åldrarna, och att träning av processhastighet skyddar mot utvecklande av depressiva symptom.

Slutsatser

I delarbetena påvisas att ålder, civilstånd, symptombörda, nedstämdhet, locus of control, funktionsförmåga och kognitiv förmåga predikterar LT i de allra äldsta.

- Symtomkontroll hos de allra äldsta är viktig om man strävar efter att bibehålla gruppens LT. Hög symptombörda och nedstämdhet kan sägas interferera med SOC-strategin som helhet då denna förutsätter ett aktivt engagemang av individen.

- Symtom-prevalensen är hög hos de allra äldsta – bara fyra personer I studiepopulationen svarade att de inte haft något symptom under de senaste tre månaderna innan basundersökningen.

- Vissa symtomgrupper påverkar LT I högre grad än andra; depressiva -, och "oros-" symtom, liksom symtom från mag-tarm kanalen och

muskuloskeletala symtom bör få uppmärksamhet i mötet med patienter ur denna åldersgrupp.

- Trettio procent av studiepopulationen rapporterade försämrad funktionsförmåga efter tre år. Förändring i funktionsförmåga var relaterad till förändring i LSI-A.

- Att på olika sätt investera i bibehållandet och/eller rehabiliteringen av funktionsförmåga hos de allra äldsta har potentialen att bibehålla eller till och med öka deras LT.

- Kognitiva förmågor inom domänerna processhastighet och spatial förmåga predikterar LT, dock i begränsad utsträckning. Hur denna kunskap ska omsättas i praktiken får vidare forskning svara på, men det finns studier som visat att kognitiv träning inom processhastighet minskar risken för att utveckla depressiva symptom.

- Att vara medveten om aspekter av personligheten, som "kontroll-plats" – var man lägger det huvudsakliga ansvaret för sin hälsa, kan vara en hjälp iatt identifiera människor med risk för låg LT. Uppfattningen att ansvaret och utfallet av ens hälsa ligger hos en själv eller hos inflytelserika andra, som tex läkare eller annan sjukvårdspersonal, verkar nämligen vara beskyddande för LT jämfört med att förlägga ansvaret till "ödet" eller slumpen. Kanske kan de förstnämnda också förmodas vara de som är mest benägna att på ett aktivt sätt tillämpa SOC-strategier i vardagen. Dessa strategier involverar förstås kognitiva processer och en bättre kognitivt rustad person borde ha bättre förutsättningar att selektera, optimera och kompensera.

- Att vara gift eller sammanboende inverkar positivt på LT. Att vara gift kan också vara ett stöd i såväl processer av optimering som kompensation då förmågorna hos den egna individen sviktar.

Det tycks bli allt svårare att kompensera för förluster ju äldre man blir. Detta beror dels på ökade förluster på olika områden i livet, dels på minskad reservkapacitet. Våra resultat pekar åt samma håll som Baltes, vilken efterlyste försiktighet i optimismen runt de allra äldstas goda åldrande.

Styrkor i studierna är att de följer deltagarna över tid och att deltagarna är slumpvis utvalda ur befolkningsregistret. Den studerade gruppen är relativt stor för att vara i den här åldersgruppen. För att undvika felvisande resultat utfördes hembesök i nästan en tredjedel av fallen. En styrka är också studiens bredd i fråga om data; en mängd såväl socioekonomiska som medicinska och psykologiska data är insamlade. Då man tittar på vilka som hoppar av studien jämfört med dem som blir kvar, är det de yngre, friskare och gladare individerna som fortsätter. Även bland dem som fortsätter, men inte fyller i LT-skalan i återbesöket, är det de med lägre LT i bas-

undersökningen som inte fyller i LT-formuläret i återundersökningen. Hade dessa individer svarat hade förmodligen sambanden som påvisats mellan LT och diverse faktorer i delarbetena varit ännu starkare. Den generella allra äldsta populationen får således antas vara i sämre form än våra deltagare; ha lägre LT, fler symptom och så vidare.

För att de mekanismer som Baltes och Baltes beskriver i SOC-teorin ska kunna fungera i den allra äldsta befolkningen krävs givetvis aktiv input av den äldre individen själv. Samhällets och sjukvårdens uppgift blir att finna vägar inom medicin och fysioterapi såväl som teknologi eller psykologi som blir till hjälp i den äldre individens process att selektera, optimera och kompensera för att uppnå ett gott åldrande.

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APPENDIX A; NEUGARTENS' LIFE SATISFACTION INDEX A

Nedanstående frågor innehåller ett antal påståenden som beskriver hur pass tillfreds man känner sig med olika aspekter på livet. Kryssa för det alternativ som först passar Dig.

Jag har haft fler möjligheter i livet än de flesta som jag känner.

1. Instämmer
2. Instämmer inte
3. Tveksam

Jag trivs lika bra och är lika tillfredsställd nu som när jag var ung.

1. Instämmer
2. Instämmer inte
3. Tveksam

Mitt liv kunde vara händelserikare än det är nu.

1. Instämmer
2. Instämmer inte
3. Tveksam

Dessa är de bästa åren av mitt liv.

1. Instämmer
2. Instämmer inte
3. Tveksam

Det mesta jag gör är enahanda och tråkigt.

1. Instämmer
2. Instämmer inte
3. Tveksam

Sådant som jag gör idag intresserar mig lika mycket som någonsin förr.

1. Instämmer
2. Instämmer inte
3. Tveksam

När jag ser tillbaka på mitt liv känner jag mig tillfreds.

1. Instämmer
2. Instämmer inte
3. Tveksam

I stort sett har jag fått ut av livet det som jag ville ha.

1. Instämmer
2. Instämmer inte
3. Tveksam

Efterhand som jag blir äldre tycks saker och ting vara bättre än jag trodde de skulle vara.

1. Instämmer
2. Instämmer inte
3. Tveksam

Detta är den mest tråkiga och enformiga perioden i mitt liv.

1. Instämmer
2. Instämmer inte
3. Tveksam

Jag ser fram emot att intressanta och spännande saker kommer att hända.

1. Instämmer
2. Instämmer inte
3. Tveksam

Jag känner mig gammal och trött.

1. Instämmer
2. Instämmer inte
3. Tveksam

Jag känner mig lika gammal som jag är men det oroar mig inte.

1. Instämmer
2. Instämmer inte
3. Tveksam

Jag skulle inte vilja byta bort eller ändra på mitt liv även om jag kunde.

1. Instämmer
2. Instämmer inte
3. Tveksam

Om jag jämför med andra som är jämngamla med mig, så har jag fattat många okloka och korttänkta beslut i min tid.

1. Instämmer
2. Instämmer inte
3. Tveksam

Jag känner mig ofta till min fördel när jag är med andra.

1. Instämmer
2. Instämmer inte
3. Tveksam

Jag planerar saker som jag beräknar göra om en månad eller ett år.

1. Instämmer
2. Instämmer inte
3. Tveksam

När jag tänker tillbaka på mitt liv, så har jag inte fått mycket av det som jag önskade och ansåg vara viktigt.

1. Instämmer
2. Instämmer inte
3. Tveksam

Jämfört med andra har jag väldigt lätt för att bli missmodig och deprimerad.

1. Instämmer
2. Instämmer inte
3. Tveksam

Oavsett vad folk säger blir människans lott efter hand sämre och inte bättre.

1. Instämmer
2. Instämmer inte
3. Tveksam

Neugartens' Life Satisfaction Index A; English version

Here are some statements about life in general that people feel differently about. Would you read each statement on the list, and put a check mark in the space next to the answer that best fits your opinion; "agree", "disagree" or if you are not sure "?". (Answering options not shown for each question below.)

1. As I grow older, things seem better that I thought they would be.
2. I have gotten more of the breaks in life than most of the people I know.
3. This is the dreariest time of my life.
4. I am just as happy as when I was younger.
5. My life could be happier than it is now.
6. These are the best years of my life.
7. Most of the things I do are boring or monotonous.
8. I expect some interesting and pleasant things to happen to me in the future.
9. The things I do are as interesting to me as they ever where.
10. I feel old and somewhat tired.
11. I feel my age, but it does not bother me.
12. As I look back on my life, I am fairly well satisfied.
13. I would not change my past life even if I could.
14. Compared to other people my age, I have made a lot of of foolish decisions in my life.
15. Compared to other people my age, I make a good appearance.
16. I have made plans for things I'll be doing a month or a year from now.
17. When I think back over my life, I didn't get most of the important things I wanted.
18. Compared to other people, I get down in the dumps to often.
19. I've gotten pretty much what I expected out of life.

20. In spite of what people say, the lot of the average man is getting worse, not better.

APPENDIX B; TIBBLINS SYMTOMSKALA, MODIFIERAD FÖR GÅS*

Besväras du sedan minst tre månader tillbaka av något av följande symtom?Markera med ett kryss på varje rad för det som stämmer in på Dig.

	Nej, inte alls	Ja, lite	Ja, ganska mycket	Ja, mycket
Lätt för att gråta				
Lättirriterad				
Svårt att kasta vatten				
Dyster/nedstämd				
Nervös				
Dålig aptit				
Trött				
Koncentrationssvårigheter				
Illamående				
Sömnbesvär				
Svårt att slappna av				
Diarré				
Överansträngd				
Rastlös				
Förstoppning				
Ont i magen				
Ledbesvär				
Övervikt				
Hosta				
Ont i ryggen				
Avmagring				
Ont i bröstet				
Ont i benen				
Svettningar				
Andfåddhet				
Svårt att gå				
Frusenhet				
Yrsel				
Huvudvärk				
Hörselnedsättning				
Ögonbesvär				
Svårt att tala/uttrycka mig				
Svårt att svälja				
Nedsatt minnesförmåga				
Svårt att hålla urin				
Svårt att hålla avföring				
Svårläkta sår				

**Symtomen svårt att gå, svårt att tala/uttrycka mig, svårt att svälja, nedsatt minnesförmåga, svårt att hålla urin, svårt att hålla avföring och svårläkta sår har i GÅS-undersökningen lagts till Tibblins originalskala.*

Appendix B; Tibblins symptomscale, modified for GÅS*

Have you been bothered by any of these symtpoms during the last three months?
Please check the alternative that best describes your situation

	No, not at all	Yes, a little	Yes, rather a lot	Yes, a lot
Cries easily				
Irritable				
Difficulty urinating				
Depression				
Nervousness				
Poor appetite				
Tired				
Difficulties concentrating				
Nausea				
Sleep disturbance				
Difficulty relaxing				
Diarrhea				
Exhaustion				
Restlessness				
Constipation				
Abdominal pain				
Pain in the joints				
Overweight				
Cough				
Backache				
Weightloss				
Chest-pain				
Pain in the legs				
Sweating				
Breathlessness.				
Difficulty walking				
Feeling cold				
Dizziness				
Headache				
Impaired hearing				
Eye-problem				
Difficulty expressing myself				
Difficulty swallowing				
Impaired memory				
Urinary incontinence				
Fecal incontinence				
Slow healing wounds				

**The symptoms difficulty walking, difficulty expressing myself, difficulty swallowing, impaired memory, urinary incontinence,fecal incontinence and slow healing wounds have been added in the GÅS-examination to the original Tibblin scale.*

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Paper I

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What factors affect life satisfaction (LS) among the oldest-old?

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ABSTRACT

Few studies have examined the association between LS in the oldest-old and not only health-related, but also psychological and socio-economical factors. The aim of this study was to examine LS in relation to functional capacity, locus of control (LoC) health status and other factors previously known to influence LS in the oldest-old. The study population consisted of 681 individuals aged 78–98 years, drawn from the longitudinal population study "Good Aging in Skåne" (GÅS), part of a national survey (SNAC) who fulfilled a questionnaire. In a regression model was shown that the number of symptoms, marital status, LoC, especially internal and powerful others, depressive mood and age significantly could predict life satisfaction three years later. Specific diagnoses like stroke, dementia and cardiac disease were not related to LS. Independence in physical functioning was related to unchanged LS, stratified for age and gender during a 3-year follow-up. The clinical implications of this study are that attention should be paid to recognizing and treating factors that affect LS and are reachable for medical intervention. Relieving symptoms and paying attention to personality factors that modify LS seem to be key-factors in the care of elderly.

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1. Introduction

The concept of life satisfaction (LS) is not just an absence of disease or disability but also includes the satisfaction of social and psychological needs (Neugarten et al., 1961). For a better understanding of what can affect LS, studies involving health concepts as potential covariates will be of utmost importance. Current knowledge is largely based on cross-sectional studies (Landau and Litwin, 2001; Berg et al., 2006) and few studies have highlighted how LS in the elderly is changing and what might explain sustained LS, a knowledge which is essential in the care of older people. Studies of this age-group with access to longitudinal data covering the majority of factors known to affect LS; medical, social, psychological and environmental, are rare.

LS refers to a person's cognitive evaluation of his life and the extent to which psychological and social needs have been satisfied, whereas the concept "wellbeing" focuses more on a persons' subjective experience of life. The superior concept "quality of life" (QoL) embraces both these terms. In the literature there is a considerable overlap between the concepts.

How much health defined on objective clinical status affects QoL is not clear. Okun et al. (1984) showed that healthy older individuals have a higher QoL than their peers with poorer health. Hillerås et al. (2001) indicated that the relationship between medically based health and QoL is low among the oldest-old. To what extent the results depend on the aging process itself, or is a consequence of cohort differences and selection is not apparent from these cross-sectional studies and study design may partly explain contradictory results. Jones et al. (2003) made a study showing a positive correlation between cognitive function, QoL and subjective well-being regardless of education and income.

A number of studies have been published showing how one or two variables were associated with LS in the elderly: Markides and Martin (1979) showed that physical activity, including activities of daily living (ADL), are related to LS. They meant that three variables can be linked to LS, namely health status, socioeconomic status and the level of "activity", and that the influence of other correlates of LS mentioned in literature are of less importance. However, their study did not include psychological variables or measures of social network.

Newsom and Schulz (1996) studied what it is that reduces the QoL when a persons' physical ability for some reason diminishes. They concluded that the reduced capacity leads to a loss of social support and social contacts, and that this is what makes the QoL decrease. A well functioning social network leads to less depressive symptoms, the presence of which have been shown to significantly predict higher risk of mortality at all ages (Collins et al., 2009).

Xavier et al. (2003) showed in 2003 that how an individual perceives his health is strongly related to QoL, at least if he thinks he has poor QoL. Health proved to be a strong predictor of worse QoL, while different factors seemed to influence what makes an individual claim to have good QoL. Relationships with family and

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friends, income and level of activity all influenced positive QoL in varying degrees. Similar findings were presented in a Swedish study of about 300 people over the age of 80 by Berg et al. (2006) in which self-rated health, depressive symptoms and marital status were associated with QoL. They concluded that a significant weakness with the study was that it was made from cross-sectional data.

Social network has according to many studies been proved to have a strong influence on the subjective well-being later in life (Pinquart and Sorensen, 2001). Landau and Litwin (2001) showed that the psychological variable LoC affects subjective well-being more than social network, and pointed to the need for multivariate analysis to increase understanding of the variation in the explanatory variables and QoL in elderly individuals.

The Project GÅS, is a longitudinal population-based cohort study that started in 2001 and comprises 2931 persons 60–99 years from five municipalities in Skåne. The study is part of the Swedish national study on aging and care, SNAC. The participants are followed by periodic re-examinations in order to increase understanding of normal aging, identify predictors of common chronic diseases in the elderly, follow the course of illness and to describe the need for and utilization of health care interventions (Lagergren et al., 2004; Ekstrom and Elmståhl, 2008).

The aim of this study is to describe how LS is related to elderly subjects' functional ability and health, to identify factors affecting LS and to what extent they can predict LS during a three year follow-up among the 681 subjects from the GÅS project, aged 78–98, that completed a 3-year re-survey. The study includes previously known factors relevant to the QoL concept such as age, sex, education, socioeconomic status, self-rated and medically based health, functional capacity, cognitive status, depressive symptoms, LoC and social network.

2. Subjects and methods

2.1. Study population

The study was designed as a sequential longitudinal population-based cohort study. A randomized selection was made from the population register of the respective age group and a letter of invitation was sent out. At baseline 1253 individuals, 78–93 years old participated. Of those 314 died, eight moved from the area and 250 chose not to take part in the 3-year reexamination.

The study population thus consisted of 681 individuals and included six age cohorts: 78, 81, 84, 87, 90 and 93 years. Five municipalities were included: Malmo, Eslöv, Hässleholm, Osby and Ystad. Participants underwent medical examination, questionnaire, neuropsychological testing and functional tests with identical study protocols at both examinations. Examination took place either at the clinic or in the participant's home. Informed consent was obtained from the participant and when needed from relatives.

2.2. Questionnaires

LS was assessed using the Neugartens' QoL Scale (LSI-A) (Neugarten et al., 1961). It is multidimensional and consists of five components of life-satisfaction: zest (vs. apathy); resolution and fortitude; congruence between desired and achieved goals; positive self-concept and mood tone. It includes 20 questions, scored from 0 to 2, to which participants had three possible answers to choose from: "disagree", "doubtful" and "agree". A high score thus indicates high LS. The participant is supposed to have a high QoL to the extent that he: (1) takes pleasure in the activities that constitute his everyday life; (2) regards his life as meaningful and readily accepts the life that has been; (3) feels he has been successful in achieving major goals in life; (4) has a positive image of self; and (5) maintains optimistic attitudes and moods.

LSI-A was constructed to be a valid and reliable instrument measuring general mental well-being in an elderly population. Cronbach's alpha reliability for internal consistency was established by Neugarten and later confirmed by Lobello et al. (2004) that found a Cronbach's alfa ranging from 0.85 to 0.92.

Subjective health was estimated from a 7-graded question"How are you feeling today?" "The score one is" much better than usual "and score seven is" much worse than usual. The occurrence of cancer, fracture, heart disease, stroke and dementia was retrieved from the medical examination, history and medical records.

Functional capacity was measured according to activities of daily life (ADL) scale of Åsberg and Sonn (1988). This contains questions covering personal ADL (p-ADL): bathing, dressing and undressing, toileting, continence, movement and food intake. Instrumental ADL (I-ADL) includes movement outdoors, cooking and shopping food, cleaning, washing, managing finances, communications and transport. Participants were categorized in three groups as functionally independent (ADL 0), dependent in at least one instrumental activity (IADL) but independent in pADL, or dependent in all instrumental activities and at least one personal activity (pADL).

The Mini Mental State Examination (MMSE), ranging from 0 to 30, was used to assess cognitive function (Folstein et al., 1975).

Depressive mood was measured with the Comprehensive Psychiatric Rating Scale (CPRS) (Montgomery and Asberg, 1979), including 10 questions, each graded in six steps involving depression, anxiety, sleep, appetite, concentration, initiative, emotional involvement, content of thoughts, and basic mood. The score ranges from 0 to 60 where 0 to 6 indicates mental well-being and 35–60 indicates severe depression.

The number of symptoms was rated with a modified version of Tibblin symptom scale covering 37 common physical and psychiatric symptoms such as headache, obstipation, pain, fatigue, restlessness, memory complaints and sleeping disturbances. Participants responded by "yes" or "no" to whether they had had or had not had symptoms during the last three months (Tibblin et al., 1990).

Three aspects of the social network were defined, a structural measure (frequency of social contacts), a functional measure (quality of the social network) and social anchorage. Structure was assessed by the question: "Do you feel the number of friends you have is enough?" Participants could choose between three alternative answers: "too few", "enough" and "too many". The first alternative was categorized as a lack of contacts and the last two were categorized as sufficient number of contacts. The quality of the social network was estimated by the question: "Do you feel that you have someone or some people who can give you a proper personal support to cope with life's stresses and problems?" Participants could choose between four alternative answers: "yes, no doubt", "yes, probably", "no, probably not", and "not at all". The answers were dichotomized into "yes" or "no" where the first two alternatives represent "yes" and the two last "no". Social anchorage was estimated through four questions: "If you're a member of an organisation, would you say that you feel a strong sense of coherence with that organisation or its' members?," "Do you feel a strong sense of coherence with your relatives?," "Are you rooted and feel a strong sense of coherence with your neighborhood?," and "Are you part of a set of friends that have common interests?." Participants were asked to answer on a four graded scale and the answers were categorized into "yes" if the answer was "yes, very much" or "to some extent", and "no" if the answer was "not particularly" or "not at all".

The health LoC scale (Walston et al., 1976) contains three subscales—one assessing internal LoC, e.g., the perception that the

individual himself has the main control over his health. "LoC power" represents the notion that health status is mainly in the hands of powerful others, such as family members or healthcare professionals. Thirdly, "LoC chance" stands for the perceived importance of luck and/or fate as main determinant over personal health.

Socio-demographic variables included age, housing categorized into rural, urban or city, gender, education (years), occupation, marital status, access to transportation and utilities. Private financial resources were assessed by three questions: "Do your financial means cover your needs?" The answer was five-graded: "very well", "well", "neither well nor insufficient", "poorly", "not at all". The three first alternatives were categorized as sufficient, and the last two as insufficient. Participants were also asked to by yes or no answer the questions: "Could you, if needed raise 14000 Swedish crowns" (about 1400€, corresponding to one third of a price base amount) and "Have you had difficulties to make ends meet when it came to running expenses during the past year?"

2.3. Ethics

The study has been approved by the regional ethics committee at Lund University, Registration no. LU 744-00. All subjects provided a written consent to participation in the study.

Table 1
Comparison of LSI-A at base examination regarding a series of parameters.

Variables	LSI-A *n*(%)	Mean ± S.D.	p-value
Sex			
Men	247 (39)	26.9 ± 6.4	
Women	389 (61)	25.2 ± 6.7	0.003
Residence			
Urban	557 (88)	26.0 ± 6.6	
Rural	78 (12)	25.3 ± 6.7	0.444
Marital status			
Married/cohabiting	376 (59)	27.4 ± 6.1	
Single/widowed/divorced	259 (41)	24.8 ± 6.8	< 0.001
Education			
≤9 years	410 (35)	25.1 ± 6.6	
>9 years	224 (65)	27.4 ± 6.5	0.001
Walking aids			
Yes	190 (31)	24.7 ± 6.8	
No	429 (69)	26.5 ± 6.4	0.003
Economical sufficiency			
Yes	414 (66)	26.7 ± 6.4	
No	208 (34)	24.4 ± 6.7	< 0.001
Quality of social network			
Yes	572 (91)	26.4 ± 6.3	
No	59 (9)	21.3 ± 7.7	< 0.001
Quantity, social network			
Yes	514 (81)	26.8 ± 6.1	
No	118 (19)	21.9 ± 7.2	< 0.001
Cardiac disease			
Yes	177 (28)	25.8 ± 6.8	
No	459 (72)	26.0 ± 6.4	0.784
Cancer			
Yes	127 (20)	25.0 ± 6.7	
No	508 (80)	26.1 ± 6.5	0.101
Stroke			
Yes	66 (10)	24.7 ± 6.4	
No	569 (90)	26.0 ± 6.7	0.135
Fracture			
Yes	218 (34)	25.1 ± 6.8	
No	414 (66)	26.3 ± 6.5	0.026
Dementia			
Yes	33 (5)	24.8 ± 6.6	
No	596 (95)	25.9 ± 6.6	0.347
ADL			
Independent	293 (46.0)	27.5 ± 6.0	
Dependent, IADL	235 (36.9)	25.1 ± 6.8	
Dependant, pADL	100 (17.1)	23.0 ± 6.8	< 0.001

Note: Significance tested with Students *t*-test and ANOVA.

Table 2
Correlation between LSI-A and a series of parameters.

Variables	LSI-A at base examination		
	n	*r*	p-value
Age	636	−0.119	0.003
LoC			
Chance	629	−0.092	0.021
Power	629	0.105	0.009
Internal	632	0.207	< 0.001
Cognition (MMSE)	608	0.127	0.002
Number of symptoms	627	−0.366	< 0.001
Worse subjective health	635	−0.116	0.004
Social anchorage	627	0.298	< 0.001
Depressive mood (CPRS)	593	−0.274	< 0.001

Note: r = Spearman's correlation coefficient (rho).

3. Statistical methods

Differences in mean values of LSI-A regarding sex, residence, marital status, education, walking aids, economy, social network, cancer, stroke, fracture and dementia were tested with Students t-test. Between ADL categories differences of LSI-A were tested using ANOVA (Table 1).

Correlation between age, MMSE, number of symptoms, self-rated health, social anchorage CPRS and LSI-A was calculated using Spearman's rho (Table 2).

In order to consider possible predictors of LS, a logistic regression model was constructed and regression coefficients were calculated. (Table 4). In the statistical tests, differences were considered significant if the p-value was <0.05, all tests were two-sided.

All statistical tests were two sided. Data analysis was performed using SPSS software version 17.0.

4. Results

The mean LSI-A score for men was 26.9 and 25.2 for women. After stratification for age the score was 26.9 for 78- to 84-year-old men as well as for 87- to 93-year-old men at the baseline examination. For women it was 25.7 at age 78–84 and 24.1 at 87–93 (Table 3).

Higher mean values of LS were noted among participants that were male, married or cohabitant, those with higher education, those reporting good economy or higher quantity or quality of social network, those independent in ADL and those without fracture (Table 1).

A positive correlation was noted between LSI-A and higher LoC, better cognitive status, more functional capacity, better self-rated health and stronger social anchorage. A negative correlation was found between higher age and depressive mood and LS (Table 2). The mean number of symptoms was 11.8 ± 6.3 (±S.D.) and significantly correlated to the LSI-A, $r = -0.37$, $p < 0.001$ (Fig. 1).

Forty-nine percent of women and 56% of men at 78–84 years old were completely independent in ADL compared to 27% of women and 42% of men of 87–93 years of age. LS in the ADL independent group did not differ between age 78–84 and 87–93 and for those whose ADL remained independent at the three-year follow-up the mean LS score was unchanged. LS of ADL-independent is statistically significantly higher than the LS of ADL-dependent in both men and women in age group 78–84 (Table 3).

In a logistic regression model was tested what factors in the base-exam that could predict LS three years later. A higher number of symptoms, higher age and depressive mood were associated with lower LS whereas being married or cohabiting and higher LoC

Table 3
Comparison of LSI-A in the age groups of men and women at base- and re-examination stratified in three functional groups.

Groups	All	ADL 0 indep.	IADL dep.	pADL dep.	p-value
78–84 years, women					
Base exam, *n*	279	136	107	36	
Mean ± S.D.	25.7 ± 6.6	27.0 ± 6.1	25.5 ± 6.4	21.2 ± 7.2	< 0.001
3-year follow-up, *n*	259	90	110	59	
Mean ± S.D.	25.5 ± 6.6	27.1 ± 6.2	24.2 ± 6.6	23.4 ± 6.4	< 0.001
78–84 years, men					
Base exam, *n*	184	103	63	18	< 0.001
Mean ± S.D.	26.9 ± 6.6	28.4 ± 5.6	25.0 ± 7.9	24.3 ± 5.4	
3-year follow up, *n*	175	80	66	29	< 0.001
Mean ± S.D.	27.1 ± 7.1	29.0 ± 5.6	26.1 ± 7.5	22.7 ± 7.6	
87–93 years, women					
Base exam, *n*	106	29	43	34	
Mean ± S.D.	24.1 ± 6.9	26.5 ± 7.2	23.7 ± 6.1	22.5 ± 7.1	0.066
3-year follow-up, *n*	87	13	36	38	
Mean ± S.D.	23.8 ± 6.1	26.9 ± 4.7	22.9 ± 6.0	23.0 ± 6.1	0.082
87–93 years, men					
Base exam, *n*	59	25	22	12	
Mean ± S.D.	26.9 ± 5.7	27.4 ± 4.1	26.3 ± 6.7	27.2 ± 4.8	0.774
3-year follow-up, *n*	50	12	24	14	
Mean ± S.D.	25.0 ± 6.6	24.5 ± 6.8	25.8 ± 6.3	21.5 ± 6.1	0.097

Note: Differences in means were tested with ANOVA.

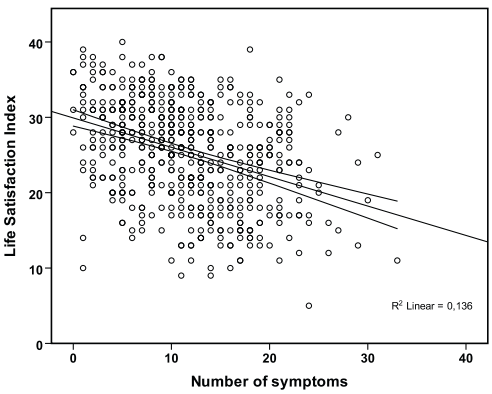

Fig. 1. Correlation between number of symptoms and LSI.

Table 4
Logistic regression model predicting LS at re-examination dichotomized by the highest tertile (variables from the base examination). n=468.

Variables	B-coefficient	p-value
Sex	−0.101	0.688
Age (decade)	−0.052	0.010
Number of symptoms	−0.075	0.001
Walking aids	0.073	0.795
MMSE	0.061	0.227
Worse Subjective health	−0.391	0.070
Residence	0.573	0.157
Education	0.290	0.059
Married/cohabiting vs. single	−0.538	0.031
Economical sufficiency	0.042	0.865
LoC-chance	−0.025	0.286
LoC-internal	0.090	0.006
LoC-power	0.066	0.029
Depressive mood	−0.086	0.014
Social anchorage	0.223	0.061
Quality of social network	0.207	0.611
Quantity of social network	−0.192	0.517
Dementia	−0.278	0.235
Fracture	−0.194	0.472
Stroke	−0.243	0.600
Cancer	−0.075	0.795
Cardiac disease	0.366	0.169
ADL	−0.090	0.651

were positively associated with LS (Table 4). Coefficient of determination (Nagelkerkes' *R* square) for this model was 0.29.

In the group that came to the reexamination, the mean age at baseline was lower, 83.1 years compared to 84.0 in the group that choose not to come and 86.6 in the group that died ($p < 0.001$). Mean scores on the LSI-A for the same groups were 25.9 as compared to 23.7 and 21.8 ($p < 0.001$), and mean number of symptoms were 11.8/12.6/14.1, respectively ($p < 0.001$). CPRS-scores were 3.5/3.9/5.3 ($p < 0.001$). There were more married/cohabiting among the participants 40% versus 33 and 32%.

5. Discussion

In this study the following five factors predicted LS three years later: number of symptoms, LoC, depressive mood, marital status and age. For those whose functional capacity remained independent during a 3-year follow up the LS maintained on a high level, whereas as functional capacity diminishes, so does LS.

The concept of LS used in this study was selected in Britain by Neugarten et al. (1961) when they studied how older people felt inside. LS refers to a person's cognitive evaluation of his life and the extent to which psychological and social needs have been satisfied. It involves an evaluation of an individuals' life compared to what he had expected of life in general. The less goals and expectations achieved, the lower the satisfaction. A person is supposed to have high LS if he/she finds pleasure in his everyday life, sees the life he lives/lived as meaningful and feels he achieved most of the goals he had for his life. Included are also questions that cover expectations for the future, self-image and whether or not the person maintains an optimistic attitude to life.

In our study we wanted to examine relations between LS and a number of health-related and psychosocial factors that could tentatively be reversible and therefore chose Neugartens' concept instead of other nearby concepts. Wellbeing describes a persons'

subjective experience of life as opposed to the objective conditions, a global experience as opposed to specific experiences from special situations or activities. LS and well-being are major contributors to the superior concept QoL (Dehlin et al., 2000).

The number of symptoms turned out to be the most influential factor in predicting LS in a three-year follow up. Subjective health was very close to reaching significance. These findings imply that the elderly persons' perception of his health impacts his LS more than medically defined health. This result supports the findings of Berg et al. (2006). They found a strong association between QoL and self-rated health in women, but in men neither medically defined health nor subjective health was related to QoL. The lack of association between medical diagnosis and LS in this study might be explained by the fact that our data say nothing about when the person had the condition. It could have occurred several years back, e.g., a cured cancer without complications and on the other hand stable and well treated condition without symptoms in contrast to symptoms asked for during the past three months. On the other hand, other studies have shown that age-related health deficits are compensated for by behavioral and psychological adjustments, thus do not necessarily affect LS negatively (Collins et al., 2009).

We noted lower LS among women than men, but gender did not remain as a significant factor explaining LS in the regression model. This might be explained by the fact that chronic disorders and symptoms are more common among women and that the factor number of symptoms in our model thereby encompasses the gender variation in LS.

Depressive mood was associated with lower LS. The presence of depressive symptoms increases with age according to several studies (Demura and Sato, 2003; Fiske et al., 2003). Studies have also shown that depression is negatively related to LS (Blazer et al., 1992) and that the presence of depressive symptoms predicts higher risk of mortality (Collins, 2009). This calls for alertness in the care of elderly as it is a factor associated with LS that actually can be affected by medication. The presence of depressive symptoms may also hinder the adjustments mentioned above thereby "allowing" health-deficits to affect LS.

In our study higher age was negatively associated with LS. Results from different studies have shown different results on this matter. Mroczek and Spiro (2005) followed almost 2000 men for 22 years and concluded that LS peaks at the age 65–70 and then declines. On the other hand, several studies show that psychological well-being is stable or even increases with age (Costa et al., 1987; Hamarat et al., 2002). Biological and social changes that come with aging does, according to these, not necessarily mean that the QoL decreases. One explanation for the noted association between age and LS could be more prevalent disorders among spouses, friends and siblings and as a possible consequence an increasing caregiver burden that is known to decrease LS (Andrén and Elmståhl, 2008). An age-dependent factor influencing LS but not included in this study, is the possibility to maintain leisure time activities. A previous multiple regression model predicting LS from the GÅS-study reported a positive association between social activities, leisure activities and LS (Ekstrom and Elmståhl, 2008).

Costa et al. (1987) concluded that the disposition and personality of the person in more useful in predicting well-being than life circumstances. Our finding that LoC affects LS is consistent with that, and internal LoC has repeatedly been found to relate to subjective well-being and LS (Johansson et al., 2001; Landau and Litwin, 2001). These studies did, however, not indicate a positive relationship between LoC power and LS as our study does. The relationship found here could represent a positive attitude of trust toward physicians and other groups of healthcare professionals. It could also reflect contentment with the Swedish healthcare system that provides citizens with healthcare at little or no cost. A tendency among the oldest-old compared to younger people to score higher on the power/chance scales and lower on the internal score has been reported (Johansson et al., 2001), and could represent a shift toward a more realistic attitude to ones' health as morbidity and disability increases with age.

Marital status was associated with LS and social anchorage was very close to reaching significance ($p = 0.061$). Being married or cohabiting is an aspect of being socially connected. Thus, the sense of affinity with family, friends, neighbors or other social groups as components of social anchorage predict LS in the elderly more than does the frequency of social contacts, feelings of loneliness and having personal support in hard times.

Strengths in this study are the longitudinal design and that it is a population based study comprising a broad context of health-related, psycho-social and cognitive factors. The study-population was large and randomly selected. Home visits were made in almost every third case to avoid selection bias. Help with interpretation was offered to people with language difficulties. Further strengths in this study were the inclusion of social, medical and psychological aspects in the model.

In the attrition analysis was noted that the participants who were more satisfied with life, of younger age and with fewer depressive and physical symptoms were those that came back to the re-examination. This may have given a more positive picture of older peoples' LS than is actually true in the general elderly population. Also, people with severe dementia were not able to complete the questionnaire.

The instruments used in this study (such as ADL, MMSE and CPRS) were standardized and internationally well-known instruments that have shown good reliability in previous validation (Folstein et al., 1975; Montgomery and Asberg, 1979; Åsberg and Sonn, 1988).

The clinical implications of this study are that attention should be paid to recognizing and treating factors that affect LS and are actually reachable for medical or other intervention. These factors need to be highlighted in the care of elderly since they may not be the natural focus of the physician who would concentrate on diagnosing and treating the current condition. Thus, carefully identifying and treating symptoms such as pain, fatigue and nausea is a vital part of the healthcare of an elderly. Being observant of depressive symptoms and if need be, offering medication could significantly influence LS, as could including the elderly in decisions concerning his own health and what kind of help he needs from society as he grows older. The healthcare system should in every possible way possible support the elderly in maintaining the network in which he feels rooted. Applying this knowledge in the everyday care of the oldest-old is a challenge for all categories of professionals working with this patient group.

Conflict of interest

None.

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Paper II

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Life satisfaction (LS) and symptoms among the oldest-old: Results from the longitudinal population study called Good Aging in Skåne (GÅS)

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ABSTRACT

Studies on the prevalence of symptoms in the general population and its' relation to LS in the oldest-old are to our knowledge non-existent. The aim of this study was to describe the frequency and experienced severity of elderly subjects' reported symptoms and how symptoms are related to LS. The study population consisted of 681 individuals aged 78–93 years, drawn from the longitudinal population study, GÅS, part of a national survey (SNAC). Scores on the life satisfaction index were related to scores on a modified version of the Göteborg Quality of Life (GQoL) instrument, covering 32 common symptoms. Musculo-skeletal symptoms like pain were reported by 74%, 80% had depressive symptoms and 68% general fatigue. Less than 6% of men and women reported no metabolic symptoms or symptoms related to the head. In a multiple regression model it was shown that four groups of symptoms could significantly predict LS 3 years later: depression, tension, GI-symptoms and musculo-skeletal symptoms. The clinical implication of this study is that careful attention should be paid to the elderly patients' complaints concerning symptoms in the above areas since this has the potential to significantly increase the patients' satisfaction with life.

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1. Introduction

Symptoms represent an uncomfortable or painful experience from some part of the body, the body in general or the psyche. In any society incalculable financial resources are spent attempting to reduce symptoms. These restrict social and physical activities and account for innumerable appointments with doctors. Symptoms represent a wide spectrum of underlying conditions, from physical disease to relational and personal distress. The reporting of symptoms is, by definition, subjective and will be colored by personality, culture and other factors. Regardless of this, the presence of symptoms influences how we perceive our health, something that in turn affects our quality of life (QoL) (Xavier et al., 2003).

Al-Windi (2005) found LS to be the strongest predictor of perceived health and the number of symptoms was independently and significantly related to perceived health. They also investigated what symptoms were associated with higher odds ratios for appointments with doctors. Using Tibblin et al.s' (1990a) symptom scale, they noted that 12 out of 30 symptoms, particularly symptoms such as depressive mood and tension, gave higher odds.

It seems, as we grow older, it gets even more important how we perceive our health as compared to medically defined health or functional status (Hillerås et al., 2001; Berg et al., 2006). To our knowledge, descriptions of the general prevalence of symptoms and its' relation to LS in the oldest-old are non-existent.

Three Swedish studies have explored the prevalence of symptoms in a general population and how it changes with age. They were all restricted to younger individuals. In the first study (Bengtsson et al., 1987) women aged 44–66 took part. The percentage of women reporting symptoms were high; about 40% reported general fatigue and depressive symptoms, and about 30% reported sleep disturbances. General fatigue and headache declined with higher age, while hearing and eyeproblems increased as might be expected. Although the complaints differed in different age groups, there was no general increase in the total number of symptoms; if anything there was a tendency for the older women to report fewer symptoms.

In the second study (Tibblin et al., 1990b), participants were of both sexes and between 26 and 67 years old. Women generally presented more symptoms than men, especially symptoms related to tension and depression, although these symptoms actually decreased with higher age. There was a tendency for pain in joints and legs, sleeping problems, breathlessness and hearing problems to increase with age while general fatigue, abdominal pain, nausea, diarrhea, cough and headache decreased.

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In the third study (Al-Windi et al., 1998), symptoms of all categories except in the groups depressive symptoms and symptoms related to tension, plus the single symptom headache increased with age. A questionnaire including 30 symptoms was used, 17 of which were significantly more prevalent in women. Only difficulty in passing urine, diarrhea and impaired hearing were more common in men. The mean number of symptoms was significantly higher for women than men in younger ages, but the difference was no longer significant above age 65. In this study though, very few of the participants were above 75, so the results cannot be considered conclusive for the older population. None of these studies sought to evaluate the relation between LS and symptoms.

The aim of this study is to describe the frequency and experienced severity of elderly subjects' reported symptoms and how symptoms are related to LS.

2. Methods

2.1. Study population

The study was designed as a sequential longitudinal population-based cohort study. The study population consisted of 681 individuals and included six age cohorts: 78, 81, 84, 87, 90 and 93 years. The first three cohorts were classified as "80-year-olds" and the three last as "90-year olds". These subjects completed both the basic survey and a 3-year re-examination as part of the ongoing study GÅS. Five municipalities were included, Malmö, Eslöv, Hässleholm, Osby and Ystad. A randomized selection was made from the population register of the respective age group and a letter of invitation was sent out.

All participants answered a questionnaire, with identical study protocols at both examinations. Examination took place either at the clinic or in the participant's home. Informed consent was obtained from the participant and when needed from relatives.

At baseline, 1253 individuals aged 78–93 participated. Of those, 681 came to the re-examination 3 years later. Of the 572 that did not come, 314 had died, 8 had moved out of the area, and 250 choose not to participate. In the group that came to the re-examination, the mean age at baseline was lower, 83.1 years compared to 84.0 in the group that choose not to come and 86.6 in the group that died ($p < 0.001$). Mean score on the LSI-A for the same groups was 25.9 as compared to 23.7 and 21.8 ($p < 0.001$) and mean number of symptoms was 11.8 ± 6.3 as compared to 12.6 and 14.1, respectively ($p < 0.001$). Of the study population, 5.4% had a diagnosis of dementia and thus took part in the examination with the help of others. 55% of those completed the LS-questionnaire, and 92% completed the symptom questionnaire.

2.2. Questionnaires

LS was assessed using Neugartens' Quality of Life scale (LSI-A) (Neugarten et al., 1961). It is multidimensional and consists of five components of LS: zest vs. apathy; resolution and fortitude; congruence between desired and achieved goals; positive self-concept and mood tone. It includes 20 questions, scored from 0 to 2, to which participants had three possible answers to choose from: "disagree", "doubtful" and "agree". A high score thus indicates high satisfaction with life. The participant is supposed to have a high LS to the extent that he: (1) takes pleasure in the activities that constitute his everyday life; (2) regards his life meaningful and accepts readily the life that has been; (3) feels he has been successful in achieving major goals in life; (4) has a positive image of self; and (5) maintains optimistic attitudes and moods.

LSI-A was constructed to be a valid and reliable instrument measuring general mental well-being in an elderly population. Cronbach's alpha reliability for internal consistency was established by Neugarten et al. (1961). Their results were later confirmed by Lobello et al. (2004) that found a Cronbach's alpha ranging from 0.85 to 0.92.

The number of symptoms was rated with a modified version of the GQoL instrument (Tibblin et al., 1990a). The GQoL covers 30 common physical symptoms that the subject has or has not experienced during the last 3 months. The symptoms are divided into eight domains: depression (exhaustion, sleeping disturbance, general fatigue, low-spiritedness, tearful), tension (irritability, nervousness, impaired concentration, difficulty relaxing, restlessness), gastro-intestinal and urinary symptoms (poor appetite, nausea, diarrhea, constipation, abdominal pain, urinary incontinence), musculo-skeletal symptoms (pain in the joints, backache, pain in the legs), metabolic symptoms (feeling cold, sweating, weight-loss, overweight), cardiopulmonary symptoms (cough, chest pain, breathlessness), symptoms related to the head (dizziness, headache, impaired hearing, and eyeproblems). We added two symptoms, namely "difficulty passing urine" and "memory impairment", made a separate group out of the two symptoms related to the urinary tract, and let the memory impairment be a group of its' own. The study thus consisted of 32 symptoms and participants could choose between four degrees of severity in the answer: "no, not at all", "yes, a little", "yes, quite a lot" and "yes, a lot".

2.3. Ethics

The study has been approved by the regional ethics committee at Lund University, Registration no. LU 744-00. All subjects provided a written consent to participation in the study.

2.4. Statistical methods

Comparison of proportions of men and women in the nine domains of symptoms was tested with Chi-squared test (Table 1). Correlations between four-graded symptoms and groups of symptoms at baseline and LS at follow-up were tested using Spearman's correlation coefficient (Tables 2 and 3). A multiple regression model was constructed with LS-score as dependent variable and the different symptom-groups as explanatory variables, regression coefficients were calculated (Table 4). Level of significance was set to $p < 0.05$. Data analysis was performed using SPSS software version 17.0

3. Results

General fatigue was the most common symptom: 67.7% reported this complaint to some degree. Second most common was memory- and hearing-impairment (59.7% and 54.9%, respectively) (Table 5).

Table 1
Prevalence of the nine domains of symptoms (%) among older men and women with degree of severity categorized in two groups as mild/moderate and high.

Symptoms	M, 80	F, 80	*p* -	M, 90	F, 90	*p*
Depression	55/22	51/34	0.078	60/16	45/39	<0.001
Tension	53/14	60/12	0.559	51/7	56/15	0.015
GI-tract	24/9	37/6	0.053	40/4	37/15	0.005
Musculo-skeletal	50/22	46/31	0.187	44/25	38/40	0.009
Metabolic	49/48	52/45	0.896*	45/51	44/50	0.601
Cardiopulmonary	45/9	39/15	0.295	49/4	35/19	<0.001
Related to head	69/28	69/27	1.000*	66/29	50/44	0.007
Urinary	26/6	29/8	0.641	28/6	25/12	0.198
Memory impairment	59/6	47/8	0.067	62/10	46/10	0.037

* Significance tested with Fishers' test.

Table 2
Correlation coefficients between nine domains of symptoms at baseline and LSI-A 3 years later.

Symptoms	(r)[a]	p	Number
Tearful	−0.119	0.005	560
Exhaustion	−0.160	<0.001	560
Sleepingproblems	−0.230	<0.001	561
General fatigue	−0.310	<0.001	560
Low-spirited	−0.266	<0.001	560
Nervous	−0.251	<0.001	558
Difficulty relaxing	−0.245	<0.001	559
Irritable	−0.158	<0.001	560
Difficulties concentrating	−0.189	<0.001	560
Restlessness	−0.170	<0.001	560
Poor appetite	−0.214	<0.001	560
Nausea	−0.154	<0.001	560
Diarrhea	−0.161	<0.001	560
Constipated	−0.159	<0.001	559
Abdominal pain	−0.192	<0.001	559
Pain in the joints	−0.190	<0.001	561
Backache	−0.264	<0.001	561
Pain in the legs	−0.226	<0.001	560
Feeling chilly	−0.206	<0.001	560
Overweight	−0.045	0.283	561
Weightloss	−0.149	<0.001	559
Sweating	−0.137	0.001	560
Cough	−0.107	0.011	560
Chestpain	−0.107	0.011	560
Breathlessness	−0.173	<0.001	560
Dizziness	−0.188	<0.001	561
Headache	−0.139	<0.001	560
Hearing impairment	−0.100	0.017	560
Eyeproblems	−0.176	<0.001	559
Memory impairment	−0.099	0.020	560
Urinary incontinence	−0.083	0.050	561
Difficulty urinating	−0.054	0.206	560

[a] Spearmans rho.

The symptoms were categorized into predefined groups. The group that most 80-year old men and women and 90-year old men reported mild symptoms from was symptoms related to the head. For women in their 90s, tension-symptoms were the commonest to have in a mild form. In both age-categories, and for both genders, the metabolic symptoms were the commonest to have to a more severe degree (Table 1).

A significantly negative correlation was found between all symptoms at baseline and LS 3 years later except for being overweight and difficulty urinating. The strongest correlations were noted between LS and fatigue and being low-spirited, both symptoms included in the depression domain (Table 2).

The strongest negative correlations to LS were found in the symptom-groups depression, tension, musculo-skeletal and GI-tract (Table 3).

Finally, a multiple regression analysis was carried out with LS-score at re-examination as dependent variable and all the nine different symptom-groups at baseline as explanatory variables.

Table 3
Correlation coefficients between the nine domains of symptoms at baseline and LSI-A 3 years later.

Symptom-group	(r)[a]	p	Number
Depression	−0.379	<0.001	559
Tension	−0.299	<0.001	558
GI-tract	−0.289	<0.001	558
Musculo-skeletal	−0.291	<0.001	560
Metabolic	−0.218	<0.001	559
Cardiopulmonary	−0.189	<0.001	560
Symptoms related to head	−0.247	<0.001	559
Urinary	−0.074	0.080	560
Memory impairment	−0.099	0.020	560

[a] Spearmans rho.

Table 4
A standard multiple regression model with all nine domains of the symptoms as the independent variable and LS index 3 years later as the dependent variable, $n = 554$.

Symptom group	B	p
Depression	−0.661	<0.001
Tension	−0.338	0.017
GI-tract	−0.821	<0.001
Musculo-skeletal	−0.334	0.031
Metabolic	0.159	0.563
Cardiopulmonary	0.222	0.356
Head-symptoms	−0.215	0.194
Urinary	0.112	0.707
Memory impairment	0.014	0.875

Depression, tension, GI-symptoms and musculo-skeletal symptoms came out significant at the $p < 0.05$ level.

4. Discussion

The concept of life satisfaction used in this study was selected by Neugarten et al. (1961) in Britain. LS refers to a persons cognitive evaluation of his life and the extent to which psychological and social needs have been satisfied. It involves an evaluation of an individuals' life compared to what he had expected of life in general. The less goals and expectations achieved, the lower the satisfaction. A person is supposed to have high LS if he finds pleasure in his everyday life, sees the life he lives/has lived as meaningful and feels he achieved most of the goals he had for his life. Included are also questions that cover expectations for the future, self-image and whether or not the person maintains an optimistic attitude to life. Our results show that four symptom groups can predict LS in a significant way, namely "tension", "GI-tract", "depression" and "musculo-skeletal".

Table 5
Prevalence of symptoms (%) among elderly men and women with degree of severity categorized in two groups, as mild/moderate and high.

	M, 80	F, 80	M, 90	F, 90	Total (n)
Tearful	18/4	32/8	18/2	28/8	652
Exhaustion	9/0	9/2	13/0	7/2	651
Sleep disturbances	31/7	35/21	24/4	30/14	652
General fatigue	56/9	51/18	51/15	48/22	651
Low-spirited	30/5	34/4	27/0	29/5	651
Nervous	27/2	34/3	19/0	36/6	648
Difficulty relaxing	25/5	41/8	19/3	27/8	651
Irritable	39/5	41/4	25/0	36/6	651
Difficulties concentrating	31/5	36/4	32/6	34/4	650
Restlessness	24/3	25/4	19/1	24/3	651
Poor appetite	7/1	11/2	10/4	13/6	652
Nausea	5/1	10/1	12/1	10/2	650
Diarrhea	10/1	9/3	10/0	8/2	650
Constipation	12/4	19/4	26/4	23/8	649
Abdominal pain	12/2	21/3	13/3	17/5	650
Pain in the joints	39/9	34/19	40/10	30/22	651
Backache	32/11	38/20	43/10	32/22	652
Pain in the legs	36/14	36/23	43/15	39/22	651
Feeling cold	24/4	24/9	28/4	22/9	652
Overweight	25/6	34/9	13/3	20/4	652
Weightloss	7/2	9/1	12/0	14/3	651
Sweating	16/4	19/3	13/1	12/8	652
Cough	24/3	17/9	26/1	18/6	651
Chestpain	16/1	15/3	28/0	12/2	651
Breathlessness	30/5	30/11	31/3	30/13	651
Dizziness	25/4	32/7	41/4	34/11	653
Headache	11/2	21/3	12/0	19/3	651
Hearing impairment	36/19	33/15	47/15	41/26	652
Eyeproblems	28/11	37/20	36/23	37/32	629
Memory impairment	59/6	47/8	62/10	46/10	650
Urinary incontinence	17/3	27/8	26/4	32/14	653
Difficulty urinating	13/4	4/1	18/4	4/0	652

The burden of symptoms in the oldest-old is surprisingly high. Less than 5% in our sample do not report any complaint in the symptom categories related to the head, and metabolic symptoms. Likewise, only about 15% of the women report no depressive symptoms and only between 20% and 30% of our study population claim to be free of musculo-skeletal pain.

As stated before, the reporting of symptoms is subjective and will be colored by personality and cultural background. Tibblin et al. (1990b) underlined that there is a risk that the actual measuring of a phenomenon like symptoms may alter the phenomenon itself since merely asking people about their symptoms may cause them to attend to their bodies in a way they would usually not.

It has been discussed how it comes that women report more symptoms at all ages, take more painkillers and visit the doctor more often (Pennebaker, 1982). In our study, the older category of women had more symptoms than men in all groups except for memory impairment, metabolic symptoms and urinary symptoms in contrast to the younger group aged 78–84 years. In the groups that turned out to affect LS the most, the 90-year old women had more symptoms than the men of the same age. It has been suggested that women are more attentive to their internal state (Pennebaker, 1982). It could also be less culturally accepted for a man to admit to a problem and ask for help. Concerning pain, studies of experimentally induced pain have been published that showed a tendency for women to experience greater pain intensity and sensitivity than men (Fillingim and Maixner, 1995).

Symptoms in the categories "tension" and "depression" are often treated as one entity and are assessed as part of a depressive condition (Montgomery and Asberg, 1979). Studies have shown that depression is negatively related to LS (Blazer et al., 1992), and that the presence of depressive symptoms significantly predicts higher risk of mortality (Collins et al., 2009). The condition is thought to be highly under-diagnosed and thus under-treated, especially in the oldest-old. This could be due to several reasons, atypical presentation may make the condition hard to recognize, both for the professional and the patient. There may be a misinterpretation that the depressive symptoms are part of the normal aging process, and the elderly individual may be more ashamed to admit to depressive symptoms than a younger person. The reported depressive symptoms might reflect a state of depressive mood and should not be mixed up with a condition of depression since the questions do not fulfill the ICD criteria for depression.

An interesting finding from earlier studies (Tibblin et al., 1990b; Al-Windi et al., 2002) is that symptoms of a depressive and tensive kind seem to decrease with age, as other symptoms increase. Unfortunately, only few individuals in these studies were above 75 years. According to several other studies, the presence of depressive symptoms increases with age, especially among the old-old women (Demura and Sato, 2003; Fiske et al., 2003). The prevalence might be u-shaped with lower numbers in the young-old age. In our material the trend in women is that the depressive and tensive symptoms get more severe in higher age. The presence of these symptoms is higher in women, but it's noteworthy that only about 25% of the men claim to be totally free from symptoms in this area. The younger men report less mild but more severe symptoms of depression while the tensive symptoms seem to decrease. Both symptom-groups could predict LS 3 years later in a significant way. Perception of low LS may reflect the depressive affect in the respondent thus making the variables confounded. The presence of depressive symptoms may also hinder the adjustments that the elderly individual would normally make to age-related health-deficits, thus allowing those to affect LS more than they would an average elderly. Nevertheless, this knowledge holds a potential for healthcare professionals to increase the LS of the oldest-old since studies have shown that 90% of people with "depression of the elderly" respond well to anti-depressive medical treatment (Gottfries and Karlsson, 2001). Improvement of the social network has also been shown to significantly diminish depressive symptoms (Blazer et al., 1992; Demura and Sato, 2003). A suggestion for further research would be to what degree the depressive symptoms in the oldest-old fulfill the clinical criteria for depression and if treated, what the effects would be on LS.

In our study symptoms from the GI-tract were significantly predictive of LS 3 years later. Fewer participants reported having GI-symptoms but for those that did, the correlation to LS was evident. Some of these symptoms like nausea and poor appetite might be drug related adverse events, but to what extent is not possible to detect with this study.

It's interesting that groups of symptoms known to interrelate are those affecting LS the most. An earlier study has shown that there is an association between QoL, pain and depressive mood in the oldest-old (Jakobsson et al., 2003). In our study the correlation between musculo-skeletal pain and depression was also significant with a coefficient of 0.47. Chronic pain is common and often a major problem among older people. The percentage of participants reporting pain from one or more locations is similar to what was found in Brattberg et al. (1996). Whether the prevalence decreases or increases with age is disputed. Jakobsson et al. (2003) saw a tendency for prevalence as well as severity of pain to increase with higher age. Brattberg et al. (1996) found that the prevalence of pain in the oldest old decreases in women so that the group 85+ has less complaints than women aged 77–79. In men, the prevalence of severe pain increases with higher age. In our population, 31% of the 80-year old women reported severe pain, in contrast to 40% of the 90-year olds. Among men, the 22% of the 80-year old had severe pain compared to 25% of the 90-year olds. The overall prevalence was basically unchanged but nevertheless high and it does affect LS. This block of symptoms including depression, tension and pain is definitely a target area for people working with the oldest-old with a large potential to increase LS.

An interesting finding was the lack of association between urinary symptoms overweight and LS. One explanation for the lack of association regarding urinary symptoms might be the access to aids that could compensate for incontinence and difficulty urinating. As for overweight, psychological explanations like self-image and locus of control might be hypothesized.

In the regression model neither cardiopulmonary symptoms nor memory complaints were related to LS. The cardiopulmonary symptoms like cough and breathlessness could reflect an underlying congestive heart failure or chronic obstructive pulmonary disease. The lack of association to LS 3 years later could express either an improved medical treatment or compensatory changes of social participation.

Our study population was large and randomly selected from the population using the National Population Registry. No exclusion was made depending on living conditions. Home visits were made in almost every third case to avoid selection. Help with interpretation was offered to people with language difficulties.

In the attrition analysis was noted a tendency for participants with higher scores on the LSI-A index and less symptoms to continue in the study. This may have given an even more positive picture of older peoples' LS and burden of symptoms than is actually true in the general elderly population, despite the high prevalence of many symptoms. Among people with a diagnosis of dementia, a rather high percentage did not complete the LS-questionnaire (45%) and generalization of findings to persons suffering from dementia might be questioned. However, 92% completed the questionnaire on symptoms but there is still a risk of underreporting of symptoms among the participants with moderate dementia.

The conclusion of this exploratory study is that symptoms in the groups tension, depression, musculo-skeletal and gastrointestinal affect elderly peoples' LS in a significant way. The groups of symptoms that influenced LS the most tend to enhance one another. Careful attention should be paid to complaints that the elderly patient has concerning symptoms in these areas since this has the potential to significantly lower the patients' satisfaction with life and might be affected by medical treatment. Symptoms may not be the main focus of the physician who might rather concentrate on diagnosing and treating an underlying condition. Applying this knowledge in the everyday care of the oldest-old is a challenge for all categories of professionals working with this patient group.

Conflict of interest statement

None.

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Paper III

Clinical Interventions in Aging

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ORIGINAL RESEARCH

Associations between functional ability and life satisfaction in the oldest old: results from the longitudinal population study Good Aging in Skåne

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Objectives: To describe change in functional ability in the oldest-old population during 3 years and examine its relation to life satisfaction (LS). A total of 681 individuals aged 78 and older from the population-based study Good Aging in Skåne took part.

Methods: Functional ability was assessed using Sonn and Åsberg's Activities of Daily Living (ADL) scale and related to LS assessed by Neugarten et al's Life Satisfaction Index A (LSI-A).

Results: Fifty-one percent of 87–93-year-olds reported ADL decline during 3 years. Individuals reporting impaired ADL had a mean LSI-A value of 23.0 compared to 26.4 in those unchanged. ADL decline had a stronger negative effect on LS in the younger group (78–84 years), $r = 0.207$, $P < 0.001$. In a multiple regression model, one score's decline in ADL capacity corresponded to 1.5 scores lower LS ($P < 0.001$).

Discussion: Effort put into keeping the oldest old on a high level of functional ability has the potential to maintain the LS of this population.

Keywords: life satisfaction, functional ability, longitudinal, oldest old

Introduction

During the last few decades, there has been great optimism in gerontology due to increased longevity and improved health and quality of life in the elderly population. Researchers such as Baltes and Smith, though, have highlighted the vast difference in prerequisites of the young old and the oldest old, and called for caution in optimism concerning the latter group: the more vulnerable, frail and those "at the limits of their functional ability."[1] Different definitions are in use when it comes to the term "oldest old"; some use it for individuals aged 85 and above, some use 80 as the lower limit. In this study, we chose the latter limit to increase power in the study.

Baltes is well known for his aging theory of selective optimization with compensation (SOC).[2] Very briefly, selection implies focusing on areas of high priority as age-related losses in functioning put a limit to previous possibilities. Optimization means investing in behaviors that augment and maximize reserve capacities, and *compensation* means finding ways – for example, psychological or technological – to compensate for losses. In this framework, he concludes that as people age, the discrepancy between subjective and objective health increases. The elderly individual assesses his/her health as much better than an outside observer would as a psychological means of nurturing well-being and life satisfaction (LS) facing decreasing functional ability and other signs of declining health. Psychological coping strategies have been shown to mediate the effect between declining health and well-being.[3]

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In the oldest old, the capacity to adapt and apply strategies to compensate is pushed to the limit as functional ability decreases; LS is thereby threatened.[1]

We hypothesized that the ability to compensate for decreasing functional ability measured as diminished activities of daily living (ADL) capacity is exceeded in the oldest old and LS is threatened. This would be true even after controlling for factors such as age, number of symptoms, depressive mood, and personality factors previously known to affect LS[4,5] and interact with functional ability. Studies in this area on the oldest old are rare, which is why we had to look for references in studies on somewhat younger individuals.

Asakawa et al[6] followed 692 elderly people in Japan for 2 years. All were functionally intact at baseline. Among those, 12.3% experienced functional decline during the follow-up. Those subjects also reported a shrinking social network, increasing depressive symptoms, and lower LS than those that remained functionally intact. Avlund et al[7] confirmed that people with decreased functional ability also have a diminished social network, something that is often considered a buffer against the negative impact of declining health.

Bowling and Grundy[8] found that worse overall health and functional decline were the most significant predictors of lower LS and more depressive symptoms among people aged 65–84 years in a 3-year follow-up. Studies have also pointed to the fact that the sense of security and the feeling that help (from relatives and/or society) is available reduces the negative influence that functional ability has on LS.[9]

A paper studying people aged 65 and above in six European countries living with reduced ADL capacity[10] concluded that it is not the reduced ADL capacity in itself that influences LS, but rather personality factors such as self-esteem, feeling worried, and the person's perception of their health. These three factors came out as significant in all six countries taking part in the study, whereas financial and social resources were significant in four out of six countries. But in a Swedish study by Hellström et al,[11] a reduced ADL capacity per se led to significantly lower LS among Swedish people aged 75 and above.

The rapid growth of the oldest-old population will mean increasing numbers of people living with some kind of functional disability. The search for clues of how to maintain LS while facing declining functional ability in the oldest old is of great importance.

The aim of this study was to describe the change in functional ability in the oldest-old population during 3 years. The aim was also to analyze possible associations between changes in functional ability during the 3-year follow-up and LS adjusted for possible covariates.

Methods

Study population

The material in this study is from a longitudinal, randomized, population-based study of the elderly called Good Aging in Skåne (GÅS), which is part of the Swedish National Study on Aging and Care.[12] It started in 2001 and includes 2931 subjects aged 60 and above. Those aged 78 and above were chosen for this paper. Subjects were reexamined after a 3-year interval.

Five municipalities in southern Sweden were included. Participants underwent medical examination and functional tests, and filled in a questionnaire with identical study protocols at both examinations. Examination took place either at the clinic or in the participant's home. Informed consent was obtained from the participant and when needed from relatives.[12]

At baseline, 1253 individuals 78–93 years old participated. Of those, 314 died, eight moved from the area, and 250 chose not to take part in the reexamination. The study population consisted of the 681 individuals who came to the reexamination, including six age cohorts: 78, 81, 84, 87, 90, and 93 years. There was no difference in attrition between men and women, but the participants aged 87 and above had significantly higher attrition for the Life Satisfaction Index A (LSI-A) variable ($P < 0.001$). A total of 109 individuals did not answer the LSI-A questionnaire in the rexamination (15.9%); those individuals had significantly lower LSI-A in baseline examination (22.6 compared to 26.4 in the group that answered LSI-A at reexamination, $P < 0.001$). For further details on attrition, refer to Enkvist et al.[13]

Questionnaires

Neugarten's LSI-A was used to assess LS.[14] It consists of five components of life satisfaction: zest versus apathy; resolution and fortitude; congruence between desired and achieved goals; positive self-concept; and mood tone. It includes 20 questions, scored from 0 to 2, for which participants had three possible answers to choose from: "disagree," "doubtful," and "agree." A high score thus indicates high LS (range 0–40). Cronbach's alpha reliability for internal consistency was established by Neugarten.[14] In our material, Cronbach's alpha was 0.78.

Functional ability was assessed through self-report according to Sonn and Åsberg's ADL scale, the revised version.[15] The nine activities included in the ADL staircase

are divided into four instrumental activities (i-ADL): transportation, cleaning, grocery shopping, and cooking; and five personal activities (p-ADL): bathing, dressing and undressing, toileting, mobility, and food intake. In our study, transportation was excluded due to high attrition for this item. Incontinence was excluded, since this has been considered an ability rather than an activity. In their study, Sonn and Åsberg also tested the scale and found good validity, and reliability was estimated at 0.9 using the Kuder–Richardson formula (KR-20). KR-20 is analogous to Cronbach's alpha, and a value above 0.65 is considered acceptable. In our study, Cronbach's alpha for ADL at baseline was 0.84.

The ADL staircase refers to the fact that the activities in the instrument can be arranged cumulatively in the form of a comprehensive nine-step ordinal scale (0–8), where 0 is given for a completely independent individual and 8 to someone dependent in all activities. Individuals needing assistance in activities such as food intake, the highest step, are likely to be dependent in all activities further down the staircase.[16] Change in the ADL staircase was calculated as ADL at baseline minus ADL at reexamination. ADL was assessed with identical protocols at baseline and reexamination.

The Montgomery–Åsberg Depression Rating Scale is a subscale of the Comprehensive Psychopathological Rating Scale (CPRS),[17] and was used to assess depressive mood. It includes ten questions, each graded in six steps concerning anxiety, sleep, appetite, concentration, initiative, emotional involvement, content of thoughts, and basic mood during the last 3 days. The score ranges from 0 to 60, where 0–6 indicates mental well-being, 7–34 mild to moderate depressive mood, and 35–60 severely depressive mood.[18] In our population, no subject scored above 35, so this variable could be split in two groups: 1 for nondepressive (n = 507) and 2 (n = 117) for mildly to moderately depressive mood. The first group had a mean score of 1.7 (standard deviation [SD] 1.9), while the second group's mean score was 11.3 (SD 4.9).

The number of symptoms was rated with a modified version of the symptom scale from the Göteborg Quality of Life Instrument.[19] Originally, the instrument included 30 symptoms; in the GÅS project, the following seven symptoms were added: difficulty walking, difficulty expressing myself verbally, difficulty swallowing, memory impairment, urinary and fecal incontinence, and slow-healing wounds. It thus contained 37 common physical and psychiatric symptoms, such as headache, obstipation, musculoskeletal pain, fatigue, restlessness, low-spiritedness, and sleeping disturbances. Participants responded with "yes" or "no" to whether they had had symptoms during the last 3 months. The score thus ranged from 0 to 37, with a mean value of 11.8 (SD 6.3).

The health locus of control (LoC) scale[20] contains three subscales, one assessing internal LoC, the perception that the individual himself has the main control over his health. "LoC power" represents the notion that health status is mainly in the hands of powerful others, family members, or health-care professionals. "LoC chance" stands for the perceived importance of luck or fate as the main determinant of personal health. The score of each subscale ranges from 6 to 30, with a higher number indicating stronger beliefs in the aspect of LoC represented by the subscale.

Financial resources were assessed by the question: "Do your financial means cover your needs?" There were five possible answers: "very well," "well," "neither well nor insufficient," "poorly," and "not at all". The first two alternatives were categorized as sufficient, and the last three as insufficient.

Married or cohabiting subjects were categorized as married, and singles, widows/widowers, and divorced subjects as singles.

Activities were subjected to a principal component analysis. The correlation matrix revealed many coefficients above 0.3. The Kayser–Meyer–Olkin value was 0.82, and Bartlett's test of sphericity reached significance ($P < 0.001$), supporting factorability of the correlation matrix. After inspection of the scree plot, three factors were used for further analysis: social, cultural, and leisure-time activities. Meeting friends/relatives, participation in study circles and nonprofit organizations, and going to restaurants were categorized as social activities. Cultural activities included going to concerts, theaters, movies, museums, art exhibitions, shows, musicals, and attending church services. Finally, leisure-time activities included long walks, gardening, repairing of cars or mechanical equipment, and traveling. Participants that had taken part at least once a year were categorized as active.

Domestic aid was assessed using the questions: "Do you receive help from relatives?" and "Do you receive help from the community?"

The subject was asked if he/she used any walking aids in- or outdoors. Answers were categorized as "yes" or "no."

The subjects were categorized into two groups depending on whether their level of education was elementary school or high school and/or university.

Ethics

The study was approved by the regional ethics committee at Lund University, registration no LU 744-00. All subjects provided written consent for participation in the study.

Statistical methods

Differences in proportions in ADL change between men and women, the younger and the older age-group, higher/lower education, and married/single were tested with the chi-squared test (Table 1).

The population was stratified by gender, age, marital status, and education. Analysis of variance (ANOVA) was used to calculate mean LSI values for functionally impaired, unchanged, and improved in each group (Table 2).

Differences in mean values of LSI-A at reexamination regarding sex, age, marital status, education, walking aids, economic sufficiency, help from relatives, social services, and social, cultural, and leisure-time activities were tested with Student's *t*-test (Table 3). The LSI-A was normally distributed.

Correlations between LSI-A at reexamination and difference in ADL, depressive mood, and number of symptoms in the baseline examination were calculated using Spearman's correlation coefficient rho due to skewed distribution (Table 3). A linear multiple regression model was constructed with LSI as dependent variable, and regression coefficients were calculated. Independent variables included in the regression model were those that showed significant differences associated with levels of LSI-A when the level of significance was set to $P < 0.2$. The higher *P*-value, compared to the more common value of <0.05, was chosen not to exclude variables that might have a decisive influence on LS.

All statistical tests were two-sided. Data analysis was performed using SPSS software version 18.0 (IBM, Armonk, NY).

Table 1 Changes in activities of daily living (ADL) functioning broken down by sex, age, marital status, education, and included subitems

	ADL-function			*P*-value
	Unchanged (%)	Impaired (%)	Improved (%)	
Sex				
Male/female	131/236 (58/65)	72/105 (32/29)	21/23 (9/6)	0.209
Age				
78–84/ 87–93 years	309/58 (70/40)	103/74 (23/51)	31/13 (7/9)	<0.001
Marital status				
Married/single	152/215 (64/61)	65/111 (28/32)	19/25 (8/7)	0.557
Education				
Elementary/high school or universtiy	236/230 (62/63)	117/59 (31/28)	25/19 (7/9)	0.488
ADL items				
Cleaning	515 (76)	105 (15)	15 (2)	
Grocery shopping	521 (77)	102 (15)	16 (2)	
Cooking	515 (76)	92 (14)	30 (4)	
Bathing	572 (84)	63 (9)	4 (1)	
Dressing	599 (88)	33 (5)	6 (1)	
Toileting	593 (87)	41 (6)	5 (1)	
Mobility	630 (93)	24 (3)	0	
Food intake	641 (94)	5 (1)	0	
ADL scale	367 (62)	177 (30)	44 (8)	

Note: Differences in proportions tested with chi-squared test.
Abbreviation: ADL, activities of daily living.

Table 2 Comparison of mean Life Satisfaction Index A (LSI-A) value at reexamination for unchanged, impaired, and improved activities of daily living (ADL) stratified by sex, age, marital status and education

ADL	LSI-A value			*P*-value
	Unchanged	Impaired	Improved	
Sex				
Male	27.3 (6.6)	24.4 (7.3)	27.6 (7.2)	0.017
Female	25.9 (6.1)	22.0 (6.7)	25.4 (5.5)	<0.001
Age (years)				
78–84	26.4 (6.4)	23.5 (7.6)	27.5 (6.0)	<0.001
87–93	26.5 (6.0)	22.2 (6.0)	23.7 (7.3)	0.002
Marital status				
Married	27.3 (6.6)	25.6 (6.4)	27.2 (7.1)	0.233
Single	25.7 (6.0)	21.1 (6.9)	25.9 (5.8)	<0.001
Education				
Elementary	26.0 (6.3)	22.2 (7.1)	24.6 (5.7)	<0.001
High school/ university	27.3 (6.3)	24.3 (6.8)	28.8 (6.7)	0.008

Note: Differences in means tested with analysis of variance, standard deviations in parentheses.

Results

A total of 177 individuals (30%) reported impaired ADL function 3 years later, 82 of which were impaired by one step, 44 two steps, 24 three steps, 13 four steps, 8 five steps, 4 six steps, and 2 seven steps. On average, this group had declined by 1.7 steps in ADL-function. A total of 367 individuals (62%) reported unchanged ADL, while 44 (8%) scored higher in the reexamination, of whom 40 had increased in ADL function by one step, three subjects by two, and one by three steps. The whole study population was impaired by a mean value of 0.6 steps in the ADL staircase during the 3 years. The younger group – individuals aged 78–84 years – were impaired by 0.4 steps compared to the older group – individuals aged 87–93 – which decreased by 1.0 step ($P < 0.001$). The greatest decline in ADL was, as might be expected, in the older group, in which 51% reported a decline during the 3 years, compared to 23% among the younger subjects ($P < 0.001$). Even if results were not significant, the tendency was that more men reported impaired ADL compared to women: 32.1% compared to 28.8% (Table 1).

Table 3 Comparison of means of Life Satisfaction Index A (LSI-A, range 0–40) at reexamination and variables at baseline examination

Variables	n	LSI at reexamination Mean[a]/standard deviation	*P*-value
Sex			
Men	226	26.3/7.0	
Women	346	24.7/6.5	0.006
Age (years)			
78–84	430	25.7/6.8	
87–93	142	23.8/6.3	0.005
Marital status			
Married/cohabiting	246	26.7/6.6	
Single/widowed/divorced	323	24.2/6.6	<0.001
Education			
Elementary school	364	24.7/6.6	
High school/university	203	26.4/6.7	0.003
Walking aids			
Yes	161	23.6/6.6	
No	410	26.0/6.6	<0.001
Economical sufficiency			
Yes	421	25.9/6.5	
No	144	23.6/6.9	<0.001
Help from relatives			
Yes	112	22.7/6.3	
No	426	26.1/6.6	<0.001
Social services			
Yes	63	23.6/6.7	
No	495	25.6/6.6	0.003
Social activities			
Yes	500	25.7/6.6	
No	55	22.7/7.0	0.003
Cultural activities			
Yes	427	25.9/6.5	
No	130	23.8/7.0	0.003
Leisure-time activities			
Yes	472	25.8/6.6	
No	86	22.9/6.8	<0.001
Depressive mood (comprehensive psychopathological rating scale)			
No	507	25.1/6.4	
Yes	117	22.2/6.8	<0.001

Notes: Significance tested with Student's *t*-test; [a]Spearman's correlation coefficient r (rho).

When the different items in the ADL staircase were separated, the greatest declines were reported for cleaning, grocery shopping, and cooking.

Differences in mean LSI value stratified for sex, age, marital status, and education were compared for unchanged, impaired, and improved ADL function (Table 2). The group that reported impaired ADL had a mean LSI value of 23.0 compared to 26.4 in the group that was unchanged ($P < 0.001$) (Table 2). There were significant differences in LSI-A between all groups except for the married group. Post hoc tests (Tukey) revealed significant differences at the <0.05 level between unchanged and impaired ADL for men, women, 87–93-year-olds, and the group with lower education. For 78–84-year-olds, singles, and the higher educated, differences were significant between unchanged and impaired ADL, as well as for impaired and improved ADL. For married subjects, there were no significant differences depending on change in ADL.

A higher mean value of LSI-A was noted for male gender, lower age, being married, higher education, being without walking aids, better economy, managing without help from family or social services, partaking in different activities, and no depressive mood (Table 3). A negative correlation was found between LSI-A and impaired ADL, locus of control chance, and a higher number of symptoms and depressive symptoms, in contrast to a positive correlation for locus of control internal and power (Table 4).

A linear multiple regression model was constructed in order to control for factors previously known to affect LS, such as age, number of symptoms, depressive mood, and personality factors, and factors such as walking aids and help from society or relatives interacting with functional ability. In the adjusted regression model difference in ADL, depressive mood, number of symptoms, health locus of control, education, and marital status in the baseline examination explained levels of LS 3 years later (Table 5).

Associations between changes of LSI from baseline to reexamination and change in ADL were analysed and stratified for age (Figure 1), and the younger group showed a positive association ($r = 0.207$ [$P < 0.001$]) in contrast to the older group ($r = -0.009$ [$P = 0.921$]).

Discussion

As we hypothesized, decline in ADL function predicted lower LS, as did more symptoms independently. Higher education, more internal locus of control, and cohabiting were also related to higher LS. This is in line with results from our previous study.[5] Decline in ADL capacity was significantly

Table 4 Correlations between LSI-A at reexamination and parameters from baseline examination

	n	Correlation (*r*)	*P*-value
Change in activities of daily living scale	537	–0.219[a]	<0.001
Locus of control			
Chance	556	–0.046[b]	0.276
Power	554	0.134[b]	0.002
Internal	557	0.210[b]	<0.001
Number of symptoms	554	–0.366[b]	<0.001
Depressive mood	534	–0.285[a]	<0.001

Notes: [a]Spearman's correlation coefficient *r*; [b]Pearson's correlation coefficient *r*.
Abbreviations: LSI-A, Life Satisfaction Index A; *r*, rho.

Table 5 A multiple linear regression model with independent variables from baseline examination and Life Satisfaction Index 3 years later as dependent variable

Variable	*B*-coefficient	*P*-value
Sex		
Female/male	0.438	0.474
Age	−0.128	0.086
Married/cohabiting vs single	−1.370	0.028
Education elementary/secondary	1.182	0.035
Economical sufficiency, no/yes	1.225	0.054
Depressive mood, yes/no	1.826	0.014
Number of symptoms	−0.336	<0.001
Locus of control, internal	0.239	0.001
Locus of control, power	0.153	0.019
Social activities, no/yes	1.178	0.234
Cultural activities, no/yes	1.155	0.111
Leisure-time activities, no/yes	0.808	0.361
Help from relatives, no/yes	−0.304	0.692
Help from social services, no/yes	−1.942	0.058
Walking aids, no/yes	−1.205	0.099
Change in activities of daily living scale	−1.316	<0.001

associated with lower LS, even after adjusting for partaking in social, cultural, and leisure-time activities, age, and other independent factors like economical sufficiency and social support. Reconnecting with Baltes' SOC theory discussed in the introduction,[2] we conclude that in today's society, the ability to apply SOC strategies to overcome the threat that declining functional ability constitutes on LS is limited.

Twenty-three percent of the 78–84-year-old group showed a decline in ADL function compared to 51% in the older group. This represents an increased vulnerability in the higher ages, even if this group constitutes "survivors." The main decline was seen in the I-ADL items. (One step's decline in the ADL staircase means losing independence in one item; for example, not being able to do one's own grocery shopping or cooking anymore.)

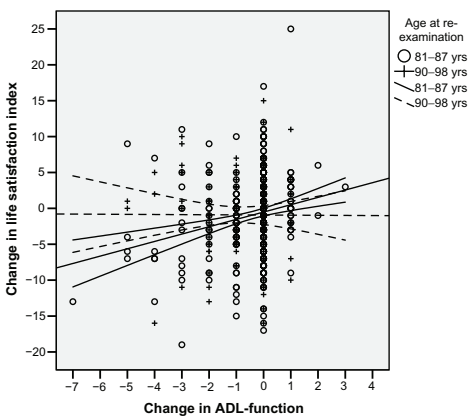

Figure 1 Change in Life Satisfaction Index A (LSI-A) from baseline to reexamination depending on change in activities of daily living (ADL) in the same period between the younger and the older group ($P = 0.0273$).
Note: The correlation between change in LSI-A and changes in ADL for the younger group (81–87 years) was $r = 0.207$ ($P < 0.001$).

Interestingly, when comparing the older group in our population to the somewhat younger one, it seems the oldest group is less affected in LS when ADL-function decreases. This could reflect lower expectations and more readiness to accept functional decline in the 87–93-year-old group. Other factors, such as an increasing burden from symptoms or losing a spouse or close friends, could have an even higher impact than declining functional ability on LS. However, the 78–93-year-old group with impaired ADL did show lower LS than the same group with unchanged ADL. In the 78–84-year-old group, there was a decline in LS as ADL declined. This could reflect a life crisis in individuals having enjoyed a totally independent life suddenly having to face needing help from spouses or formal care from society.

Functional ability in terms of number of symptoms is one of the most tangible aspects by which the elderly person perceives his health. In our previous work[5,13] conducted on the same population, the burden of symptoms had significant influence on LS, especially symptoms in the following categories: depression, tension, gastrointestinal, and musculoskeletal. Specific diagnoses such as heart failure, dementia, stroke, or fracture did not have as strong an influence on LS as the burden of symptoms. The elderly individual seems to perceive his health based on his experiences of daily life rather than objective medical findings, and the elderly person's perceived health has been shown to influence his LS.[21]

Asakawa et al[6] noted an increase in depressive symptoms with declining functional ability, but it has also been discussed that preventing and treating depression in old age might reduce functional decline.[22] Here lies the potential for interdisciplinary interaction to reach results that increase the LS of the elderly.

Our results suggest that a lower functional ability results in lower LS, regardless of the availability of help from community or family caregivers. Though not significant, there was a negative association between receiving help and LS. This might seem contradictory, but the impact on the elderly of having no choice but to receive public services has been related to psychological strain,[23] potentially negatively influencing LS. The negative association was there even for receiving help from relatives, and should probably be interpreted as an effect of the elderly persons'

loss of independence rather than having a relative prepared to help. Though the comfort of the presence of loved ones was a positive aspect, feelings of guilt for being a burden on relatives were also evident in Janlöv et al's study,[23] and could further explain the negative association with LS.

In Asakawa et al's study,[6] those reporting impaired functional ability also reported a shrinking social network and lower LS than those that remained functionally intact. We included partaking in different activities as a measure of the subjects' social life and ability to be a part of the world around them. Impaired functional ability resulted in lower LS even after this adjustment, but being married or cohabiting was associated with higher LS. Living with a spouse could, apart from providing social anchorage, buffer a decline in functional ability, as some degree of help is more available than to those living alone. The need for social services might thus be less pronounced.

Economical sufficiency did not come out as a significant factor in the regression model. Perhaps a reason for this is that the Swedish health-care system provides health care, social services, and different kinds of aids at little or no cost, buffering the impaired functional ability without the extra burden of financial worries.

The study population comprised a sample from the general population covering urban as well as rural areas. It was randomly selected using the Population Registry, thereby increasing generalization of results to the older general population. Higher ages were also included, and no exclusion was made for subjects living in residential care or homes for the elderly. Home visits were made in almost every third case to reduce selection bias. Social, medical, and psychological aspects were included in the model. Further strengths in this study are the longitudinal design and that it comprises a broad context of health-related and psychosocial factors. The instruments used in this study (such as Neugarten, ADL, and CPRS) were standardized and internationally well-known instruments that have shown good reliability in previous validations.[14–17] Proxy information was retrieved from next of kin and ward staff to ensure validity and completeness of information. Cognitive assessment by medical examination was done for all participants in a standardized way.

In the attrition analysis, it was noted that the younger participants who were more satisfied with life and had fewer depressive and physical symptoms were those that came back to the reexamination.[5] Respondents from the 87–93-year-old group constitute the main attrition in LSI-A. If these had been included, the correlation between age and decline in ADL would have been even stronger, since functional ability declines with higher age. Furthermore, the lack of association between changes of ADL and changes in LS among the oldest old might be influenced by selection bias in this group. People with severe dementia were not able to complete the questionnaire, and this condition is more prevalent with age and related to decline in functioning, thereby introducing possible bias. Efforts were made to include proxy information if possible.

One advantage of using the ADL scale is that each step is represented by a defined categorization, which makes it easy to compare different individuals' improvement or decline in ADL. It is important to remember that the steps of the scale are not equivalent, and that differences in the experience of the various steps will vary among individuals. In addition, individual differences exist between individuals on the same step.[16]

The ADL scale is a rather coarse instrument in measuring functional ability, not able to capture milder limitations that might nevertheless be experienced as a great hindrance to the person affected. In a Swedish investigation of almost 1300 people aged 60–89 years, half of the respondents reported feeling hindered by health problems in spite of having no decline in the ADL scale.[9] Even milder declines in functional ability, not measurable by ADL, have been shown to be connected with lower LS.[6]

Conclusion

High LS throughout the life span is an attractive goal to the elderly individual as well as to anyone privately or professionally engaged with individuals in this age-group. The above results confirm the hypothesis that reduced functional ability leads to lower LS, even after controlling for confounders. The results also suggest that investing in the maintenance and/or restoration of ADL capacity in the age-group 78–84 years has the potential to preserve or even increase the LS of the oldest old. If this association is not as strong for the older group, aged 87–93 years, this has consequences for how far different kinds of treatment strategies should be pushed. More research is needed to confirm and further explore these results. Another interesting area for further research would be an intervention study, testing effects on LS after rehabilitation efforts in this age-group.

Disclosure

The authors report no conflicts of interest in this work.

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Paper IV

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ORIGINAL RESEARCH

Associations between cognitive abilities and life satisfaction in the oldest-old. Results from the longitudinal population study Good Aging in Skåne

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Introduction: Studies on the associations between cognitive abilities and life satisfaction (LS) in the oldest-old are few. The aim of this study was to explore whether abilities in six different cognitive domains could predict LS in the oldest-old 3 years later.

Methods: The study population consisted of 681 individuals aged 78–98 years, drawn from the longitudinal population study "Good Aging in Skåne," which is part of a national survey (The Swedish National Study on Aging and Care). Scores on 13 cognitive tests were related to scores on Neugartens' LS index A (LSI-A) 3 years later. The cognitive tests were added into six different cognitive domains. A multiple regression analysis was constructed for each cognitive domain separately, with scores on the LSI-A as the dependent variable. The model was adjusted stepwise for sex, age, education, functional capacity, and depressive mood.

Results: Significant correlations were found between digit cancellation, word recall, verbal fluency (VF) A, VF animals, VF occupations, and mental rotations at baseline, as well as LSI-A at follow-up. The domains of spatial abilities (B = 0.453, $P = 0.014$) and processing speed (B = 0.118, $P = 0.020$) remained significantly associated with LSI-A 3 years later after adjustment.

Conclusion: The cognitive domains of spatial abilities and processing speed predicted LS 3 years later in the oldest-old. Clinical implications are discussed.

Keywords: oldest-old, life satisfaction, longitudinal, crystallized and fluid intelligence, cognition

Introduction

As the part of the population called the oldest-old is growing in number, geriatric research has partly changed focus from being preoccupied with disease and disability to focusing on life satisfaction (LS), psychological well-being, successful aging, and other related concepts. Multiple areas have been shown to influence LS in this age group – health status, burden of symptoms, functional ability, personality factors, and marital status are some examples.[1–3] The oldest-old is the group in society with the highest risk of functional decline – physical as well as cognitive. Therefore, it is of importance to explore the associations between not only physical, but also cognitive functioning and positive health outcomes such as LS, quality of life, and other related concepts. Few studies have explored the associations between LS and cognition longitudinally in the oldest-old.[4]

Jones et al[5] found higher cognitive functioning to be positively related to LS and positive affectivity. The authors highlighted the clinical relevancy in establishing the link between subjective well-being and objectively measured cognitive performance. They speculated

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that people with higher cognitive abilities would be better able to appreciate the subtle yet positive aspects of living, or that people are better fit to utilize resources and adapt to circumstances, thus facilitating happiness. The authors also pointed to the idea that many gerontological studies on LS and subjective well-being exclude persons with any degree of cognitive impairment. This makes the results easier to interpret, but also limits the study population to extremely healthy individuals, and is not totally representative of elderly people.

St John and Montgomery[6] found that people with cognitive impairment had lower LS than people scoring in the normal range of the extended version of the Mini-Mental State Examination (MMSE) that was used. The association between LS and cognitive ability was attenuated when adjusted for functional capacity and depressive symptoms, and the latter two factors seemed to influence LS stronger than cognitive abilities. The authors commented on the fact that studies of the effects of cognitive abilities on LS in the general older population are few and that most studies that explore associations between LS and cognition, concern only people with dementia and/or use methods such as the MMSE that only detect a rather marked cognitive loss.

Through researchers such as Baltes,[7] views on the aging mind have shifted from a preoccupation with cognitive decline to a perspective including potentials for growth. In his studies, he categorizes the mind into two domains – crystallized and fluid intelligence (Gc and Gf, respectively),[8] which have been illustrative in that they display different lifespan trajectories. Gf shows a constant decline after peaking in young adulthood, while Gc remains stable or may even increase throughout the lifespan. In light of this, the findings of Wolinsky et al,[9] who conducted cognitive training in domains related to Gf, are interesting. Healthy individuals above the age of 65 years were trained in three different cognitive domains: processing speed, memory, and reasoning. The results showed that individuals who had been trained in processing speed were 30% less likely to experience clinically relevant increases in depressive symptoms than either the control group or those trained in the other domains, and this effect remained after 5 years. Siedlecki et al[10] also studied the influence of Gc and Gf on adults of different ages from this perspective. The authors hypothesized that Gc would be increasingly important for LS with increasing age, while the significance of Gf would diminish with age as the individual partakes less in workplace situations and career management. In the results, however, Gc was not associated to LS at any age, while Gf was associated with the younger group (aged 18–59 years), but not with the older group (aged 60–94 years).

Baltes and Baltes[11] also defined a psychological model for the study of successful aging – the theory of selective optimization with compensation. "Selection" refers to the individuals' choice to focus on areas of high priority as they face increasing restrictions in functioning due to age related losses. "Optimization" refers to the person investing in behaviors that augment and maximize reserve capacities and the quality of their lives. Finally, as capacities decline, different forms of compensation – psychological as well as technological – become vital. Baltes[7] showed that cognitive abilities related to fluid as well as Gc can be improved by training, even in advanced ages. Society is facing a huge challenge as the oldest-old segment of the population expands. Baltes[7] discussed the problems faced as society and individuals strive to optimize living conditions and compensate for the various types of losses faced by the oldest-old, since impaired physical and cognitive abilities might limit the ability to benefit from compensations (eg technological) offered.

Previous studies have either included selective healthy study samples or they have not taken potential confounders into account. The null hypothesis for this study was that cognitive abilities in the oldest-old cannot predict LS 3 years later. The aim of this study was to explore whether results on 13 cognitive tests, administered separately and organized into six cognitive domains, could predict LS 3 years later in the oldest-old. Factors such as stroke, dementia, functional capacity, and depressive mood, known to influence or be influenced by cognitive performance as well as LS, were included as confounders in the model.

Methods

Study population

The study was designed as a longitudinal population-based cohort study with a 3 year follow-up period.[12] A randomized selection was made from the Swedish population register of the respective age group and a letter of invitation was sent out. Inclusion criteria were that the individuals had to be residents in one of the five municipalities of Skåne, and they had to be between 78 years and 93 years of age. The only exclusion criterion was if the respondent could not understand Swedish. At baseline, the target population was 1,300 individuals; of these, 1,253 individuals – 78 years to 93 years old – participated. Of those, 314 died, eight moved from the area, and 250 chose not to take part in the 3-year reexamination. The participation rate at baseline was 53.5%, which is similar to the rate of other studies that include the oldest-old.[13]

The study population thus consisted of 681 individuals and included six age cohorts at baseline: 78-year-olds, 81-year-olds, 84-year-olds, 87-year-olds, 90-year-olds, and 93-year-olds. Five municipalities from the southern part of Sweden were included: Malmo, Eslöv, Hässleholm, Osby, and Ystad. Participants filled in questionnaires and underwent medical examinations, neuropsychological testing, and functional tests with identical study protocols at both examinations. Examination took place either at the research clinic or in the participants' homes, and the participant received help to fill in the questionnaires by a research assistant if the participant asked for it. Informed consent was obtained from the participant, and when needed (if the participant was cognitively or otherwise impaired), from relatives.

The study was approved by the Ethical Committee at Lund University (LU 744-00).

Questionnaires

LS was assessed using Neugartens' Quality of Life Scale (LSI-A).[14] It is a multidimensional scale and consists of five components of LS: zest (versus apathy); resolution and fortitude; congruence between desired and achieved goals; positive self-concept; and mood tone. It includes 20 questions, which are scored from 0 to 2, to which participants had three possible answers to choose from: "disagree," "doubtful," and "agree." A high score thus indicates high LS. The participant is supposed to have a high LS to the extent that he/she: (1) takes pleasure in the activities that constitute his or her everyday life; (2) regards his or her life as meaningful and readily accepts the life that has been; (3) feels he or she has been successful in achieving major goals in life; (4) has a positive self-image; and (5) maintains optimistic attitudes and moods.

The LSI-A was constructed to be a valid and reliable instrument measuring general mental well-being in an elderly population. Cronbach's alpha for internal consistency was established by Neugarten[14] and later confirmed by Lobello et al,[15] who found a Cronbach's alpha ranging from 0.85–0.92.

The cognitive tests were organized into six domains accordingly:[16]

1. "Executive" (including Trail Making Test B [TMT B], the verbal fluency tests, and confidence).
2. "Processing speed" (including digit cancellation and comparing figures).
3. "Episodic memory" (including word recall).
4. "Spatial" (including mental rotations).
5. "Working memory" (including digit span forwards and backwards).
6. "Semantic memory" (including synonym reasoning block 1 [SRB1]).

TMT B tests executive abilities. In the Good Aging in Skåne project, a shortened version of the original TMT B is used. The participant is asked to draw a line between the correct sequence of numbers and letters in circles on a paper as fast as possible.[16] The time in seconds required to fulfill the test was measured as the outcome.

Four tests measuring verbal fluency were administered.[16] In category fluency, participants were asked to generate as many animals and occupations as possible in 60 seconds per category. For the letter fluency tasks, participants were given 60 seconds to generate as many words as they could, beginning with the letters A and F, respectively.

"Confidence" is a test of the executive abilities which encompasses the ability to plan and organize actions,[16] and also to evaluate and interrupt actions that do not yield desired results. In this test, ten questions are presented to the participant. Each question contains two sentences, of which only one is correct. Each participant is asked to identify the correct answer and then state how sure he or she is that he or she answered correctly. The range of scores for this test is 1–10, with a higher score indicating more confidence.

"Digit cancellation" measures processing speed; sustained attention, visual scanning, activation and inhibition of responses.[16] Participants are required to cross out a certain digit (in our case, digit four) among a number of randomly interspersed numbers in rows throughout the course of 30 seconds. The range of scores is 0–43.

"Comparing figures" is a test that measures perceptual speed and visuospatial ability.[16] During the course of 30 seconds, the participants are asked to decide whether two figures in different pairs are identical or not; the range of scores is 0–30.

The "word recall and recognition of positions" test, 16 cards with words on them were presented to the participant one at a time. Each card was presented for 5 seconds. The positions of the words were randomly varied. After the presentation, the participant was asked to recall as many of the words as possible during 2 minutes. The test reflects episodic and working memory.[16] Later, the same words were presented with an equal number of new words, and the participant was asked to identify those words that were in the original version and to indicate in what position the original word was. The range of scores was 0–16.

"Mental rotations" measures three-dimensional thinking and spatial ability.[21] For this test, each participant is shown an index figure and three figures, of which one is identical to the index but is rotated; the participant has to identify the latter. The range of scores is 0–10, with 10 indicating better spatial ability.

The next test that was used was the digit span test of the Wechsler Intelligence and Memory Scales, used to measure working memory.[20] The participant is supposed to repeat numbers after the test leader – initially two, then increasing numbers in a row. In the digit span backwards task, numbers are presented and the participant is to repeat as many of the numbers as he or she can in reverse order. The maximum score for both tests is 14.

Semantic memory was measured with the synonym test SRB1.[17] The participant is shown a word to which he or she is supposed to find the synonym among five alternatives. In all, 30 words are presented; the maximum score is 30, and time limit is set to 7 minutes. The test is not perceived to be age-sensitive and reflects Gc.[16]

Depressive mood was assessed with the Montgomery Åsberg Depression Rating Scale, which is a subscale of the Comprehensive Psychiatric Rating Scale.[22] This scale includes ten questions encompassing depression, anxiety, sleep, appetite, concentration, initiative, emotional involvement, content of thoughts, and basic mood. Each question is graded in six steps. The score ranges from 0–60, where 0–6 indicates mental well-being, 7–34 represents mild to moderate depressive mood, and 35–60 indicates severe depressive mood.[23] In our population, no subject scored above 35, so this variable could be split into two groups: "1" for nondepressive mood (n = 507) and "2" for mildly to moderately depressive mood (n = 117).

Functional capacity was measured according to the revised version of Sonn and Asberg's activities of daily life (ADL) scale.[24] The ADL staircase was dichotomized into two groups where subjects reporting total independence were categorized as "1" (n = 299) and subjects reporting any kind of dependence (eg, for grocery shopping, cleaning, or cooking) were categorized as "0" (n = 351).

The occurrence of stroke (diagnosed according to the International Classification of Diseases version 10) and dementia (diagnosed according to criteria from the *Diagnostic Statistical Manual of Mental Disorders*, fourth revision) was retrieved from the medical examination, and medical history and information was obtained from proxy and medical records. Subjects were categorized as "yes" or "no" for having had each of the conditions. Thirty-eight subjects had a diagnosis of dementia and 73 had a diagnosis of stroke.

The participants' level of education was categorized into two groups for stratification and three groups for the regression model. Groups were defined depending on whether the participant had fulfilled elementary school (n = 436), high school (n = 158), and/or university (n = 73).

Considering any misclassification due to test performance, a sensitivity test was carried out regarding the correlations between LS and the 13 cognitive tests. During the cognitive tests, the test leader filled in a protocol registering whether problems with eyesight (n = 92), hearing (n = 85), motor skills (n = 51), or communication difficulties (n = 28) interfered with the testing. The correlations were made again after excluding this group, and results did not differ from the total study population. Therefore, in the subsequent analyses, subjects with eyesight, hearing, motor, and communication problems were included.

Statistical methods

To make scales comparable when organized into domains, the scales were transformed using *z*-standardization according to the following formula:

$$z = x_i - m/SD \quad (1)$$

where x_i is the individual, m is the mean, and SD is the standard deviation.

Differences in the means between the group that came to the reexamination and the drop-out group were tested with Student's *t*-test (Table 1). The LSI-A and the cognitive test results were normally distributed. Correlations between cognitive variables at baseline and LSI-A at follow-up were tested using Pearson's correlation coefficient (Tables 2 and 3). Correlations were calculated for the whole sample, and were stratified for known confounders including stroke, depressive mood, low/high education, and functional ability.

Separate multiple linear regression models with cognitive domains at baseline and LSI-A at reexamination as the dependent variable were constructed (Table 4). Each model was adjusted for known confounders, with each predictor variable entered into each successive model accordingly, including sex, age, education, functional capacity, and depressive mood. Regression coefficients and *P*-values were calculated. Data analysis was performed using SPSS software version 20 (IBM Corporation, Armonk, NY, USA).

Results

The study population consisted of 418 women and 263 men; 488 individuals were between 78–84 years old, while 193 were between 87–93 years old. A total of 584 participants represented urban living, and 87 represented rural living (information was missing for ten individuals). In addition, 436 individuals had an education level equal to or less than 9 years, while 231 had studied for more than 9 years (data from 14 participants were missing).

Table 1 Results on cognitive tests, mean and SD at baseline for the study population and dropouts

Cognitive variable	Study population		Dropout		*P*-value	Range
	Mean (SD)	n	Mean (SD)	n		
Age (years)	83.0 (4.4)	681	85.4 (4.8)	572	<0.001	–
Trail Making Test B (A)	52.8 (40.5)	560	61.6 (41.9)	345	<0.002	–
Verbal fluency F (A)	12.6 (5.2)	624	10.9 (5.1)	428	<0.001	–
Verbal fluency A (A)	9.8 (4.9)	623	8.2 (4.5)	425	<0.001	–
Verbal fluency, animals (A)	17.3 (5.8)	628	14.9 (5.8)	434	<0.001	–
Verbal fluency, occupations (A)	12.8 (4.6)	621	10.6 (4.4)	429	<0.001	–
Confidence (A)	6.4 (1.6)	627	6.1 (1.6)	432	<0.001	0–10
Comparing figures (B)	9.8 (3.2)	569	8.6 (3.3)	355	<0.001	0–30
Digit cancellation (B)	14.3 (3.8)	582	13.3 (4.0)	365	<0.001	–
Word recall (C)	5.8 (2.1)	594	5.0 (2.3)	395	<0.001	0–16
Mental rotations (D)	5.5 (1.7)	557	5.4 (1.6)	343	0.420	0–10
Digit span, forward (E)	6.0 (1.7)	616	5.7 (1.7)	424	0.015	0–14
Digit span, backward (E)	4.9 (1.8)	613	4.5 (1.9)	421	<0.001	0–14
Synonym test (F)	19.1 (6.2)	605	17.2 (6.3)	385	<0.001	0–30

Note: Differences in numbers could mainly be explained by vision impairment and dementia.
Abbreviations: SD, standard deviation; n, number; A, executive functioning; B, processing speed; C, episodic memory; D, spatial abilities; E, working memory; F, semantic memory.

In the group that came to the reexamination session, the mean age at baseline was 83.0 years compared to 85.4 years in the drop-out group, $P < 0.001$ (Table 1). The mean score on the LSI-A was higher for the reexamined group (a score of 25.9 compared to 22.8 for the drop-out group; $P < 0.001$). The reexamined group also had significantly higher mean values on all cognitive tests at baseline except for the mental rotation task when compared to the drop-out group (Table 1).

To explore potential confounding effects, correlations with the LSI-A at reexamination were calculated for the whole group as well as stratified for stroke "yes"/"no," and depressive mood high/low, education high/low, and independence/dependence in functional capacity using Pearson's correlation coefficient (Tables 2 and 3). For the whole group, digit cancellation, comparing figures, word recall, TMT B score, verbal fluency A, mental rotations, as well as verbal fluency animals and occupations were significantly correlated to LSI-A.

Correlations were also calculated for age groups 78–84 years and 87–93 years, dementia (yes/no), and sex (data not shown). While significant in the 78–84-year-old group, the verbal fluency tests and comparing figures lost association to LSI-A in the older group. In both sexes, there were similar significant associations between cognitive results and scores on the LSI-A. Stratification for dementia did not affect the correlations significantly.

Correlations were calculated between cognitive domains and LSI-A 3 years later (Table 5). Of the six cognitive domains, spatial abilities ($r = 0.16$, $P < 0.001$; $R^2 = 0.03$) and processing speed ($r = 0.15$, $P = 0.001$; $R^2 = 0.02$) showed the strongest correlations to LSI-A 3 years later. Executive abilities ($r = 0.12$) and episodic memory ($r = 0.10$) were also statistically significant at the $P < 0.05$ level. Synonyms and working memory were not significantly related to LSI-A.

Multiple regression analyses were carried out for each cognitive domain separately with LSI-A at reexamination as the dependent variable. Each model was adjusted stepwise for sex, age, education, functional capacity, and depressive mood (Table 4). R^2 values for the final models were between 0.10 and 0.12 for the six different domains. Processing speed and spatial ability remained associated with LSI-A after adjustment, with $B = 0.118$, $P = 0.020$ for processing speed and $B = 0.453$, $P = 0.014$ for spatial ability.

Discussion

We found that Gf expressed by processing speed and spatial ability predicts LS 3 years later in the oldest-old. As mentioned in the introduction, most studies of associations between LS and cognition use rather coarse methods such as the MMSE that only detect a rather marked cognitive loss and typically only concern people with dementia.[6] In this study, we showed that even when using cognitive instruments designed to measure aspects of intelligence in a healthy general population, there are clear associations with LS. We can thereby reject the null hypothesis even if the attributable fraction to LS is small. Spatial abilities and processing speed each explain less than 3% each of variance in LS. From a public health perspective, factors not addressed in this study should thus be targeted firsthand when seeking to preserve

Table 2 Pearson's correlation coefficients between cognitive variables at baseline and life satisfaction index A at reexamination with *P*-values in parentheses

Cognitive variable	All	Stroke	No stroke	No depressive mood	Depressive mood
	r (*P*)	*r* (*P*) n = 73	*r* (*P*) n = 605	*r* (*P*) n = 507	*r* (*P*) n = 117
Trail Making Test (A)	–0.13 (0.004)	0.08 (0.642)	–0.14 (0.003)	–0.14 (0.006)	–0.08 (0.461)
Verbal fluency F (A)	0.07 (0.133)	0.06 (0.679)	0.06 (0.223)	0.04 (0.393)	0.25 (0.014)
Verbal fluency A (A)	0.10 (0.033)	0.01 (0.967)	0.09 (0.050)	0.06 (0.217)	0.28 (0.006)
Verbal fluency, animals (A)	0.12 (0.006)	–0.10 (0.503)	0.13 (0.005)	0.07 (0.130)	0.29 (0.005)
Verbal fluency, occupations (A)	0.13 (0.003)	–0.04 (0.804)	0.13 (0.004)	0.10 (0.047)	0.24 (0.023)
Confidence (A)	0.07 (0.086)	–0.20 (0.190)	0.09 (0.038)	0.03 (0.531)	0.15 (0.167)
Digit cancellation (B)	0.13 (0.003)	0.16 (0.333)	0.12 (0.012)	0.12 (0.014)	0.24 (0.025)
Comparing figures (B)	0.17 (<0.001)	0.26 (0.126)	0.16 (<0.001)	0.18 (<0.001)	0.16 (0.130)
Word recall (C)	0.10 (0.032)	0.18 (0.280)	0.09 (0.065)	0.10 (0.043)	0.07 (0.501)
Mental rotations (D)	0.16 (<0.001)	–0.16 (0.353)	0.18 (<0.001)	0.17 (0.001)	0.09 (0.418)
Digit span forward (E)	0.02 (0.724)	0.03 (0.868)	0.01 (0.830)	–0.02 (0.667)	0.18 (0.091)
Digit span backward (E)	0.07 (0.101)	0.11 (0.868)	0.06 (0.172)	0.07 (0.163)	0.11 (0.309)
Synonym test (F)	0.03 (0.045)	–0.04 (0.804)	0.03 (0.453)	–0.01 (0.813)	0.15 (0.142)

Note: Baseline variables for the whole study population as well as stratified for stroke and depressive mood.
Abbreviations: A, executive functioning; B, processing speed; C, episodic memory; D, spatial abilities; E, working memory; F, semantic memory.

Table 3 Pearson's correlation coefficients between the Life Satisfaction Index A at reexamination and cognitive variables at baseline stratified for education and functional capacity (ADL)

Cognitive variable	High education	Low education	ADL, independent	ADL, dependent
	r (*P*) n = 231	*r* (*P*) n = 436	*r* (*P*) n = 299	*r* (*P*) n = 351
TMT B (A)	–0.14 (0.052)	–0.13 (0.021)	–0.13 (0.045)	–0.10 (0.141)
Verbal fluency F (A)	0.05 (0.475)	0.02 (0.666)	–0.06 (0.325)	0.136 (0.029)
Verbal fluency A (A)	0.05 (0.323)	0.06 (0.381)	–0.02 (0.738)	0.15 (0.013)
Verbal fluency animals (A)	0.21 (0.004)	0.03 (0.543)	0.06 (0.295)	0.14 (0.019)
Verbal fluency occupations (A)	0.15 (0.037)	0.07 (0.196)	–0.002 (0.975)	0.19 (0.002)
Confidence (A)	0.09 (0.196)	0.03 (0.531)	0.07 (0.243)	0.07 (0.255)
Comparing figures (B)	0.13 (0.084)	0.17 (0.003)	0.11 (0.081)	0.21 (0.001)
Digit cancellation (B)	0.11 (0.151)	0.14 (0.015)	0.04 (0.524)	0.16 (0.013)
Word recall (C)	0.14 (0.062)	0.05 (0.355)	0.12 (0.052)	0.02 (0.724)
Mental rotations (D)	0.23 (0.002)	0.11 (0.062)	0.15 (0.018)	0.17 (0.008)
Digit span, forward (E)	–0.07 (0.317)	0.03 (0.537)	–0.06 (0.301)	0.04 (0.500)
Digit span, backward (E)	0.07 (0.309)	0.03 (0.552)	–0.01 (0.872)	0.11 (0.085)
Synonyms (F)	0.09 (0.199)	–0.04 (0.452)	–0.02 (0.701)	0.04 (0.574)

Abbreviations: A, executive functioning; B, processing speed; C, episodic memory; D, spatial abilities; E, working memory; F, semantic memory.

Table 4 Linear regression models with the LSI-A at reexamination as the dependent variable and cognitive domains at baseline as the independent variables

LSI-A	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Executive abilities	0.045 (0.010)	0.045 (0.010)	0.041 (0.018)	0.030 (0.115)	0.018 (0.349)	0.014 (0.444)
Processing speed	0.165 (0.001)	0.177 (<0.001)	0.161 (0.001)	0.139 (0.006)	0.117 (0.020)	0.118 (0.020)
Episodic memory	0.302 (0.032)	0.345 (0.014)	0.303 (0.031)	0.252 (0.078)	0.194 (0.172)	0.188 (0.185)
Semantic memory	0.038 (0.445)	0.044 (0.368)	0.033 (0.502)	–0.008 (0.882)	–0.033 (0.518)	–0.056 (0.289)
Spatial abilities	0.639 (<0.001)	0.569 (0.002)	0.554 (0.002)	0.498 (0.007)	0.505 (0.006)	0.453 (0.014)
Working memory	0.107 (0.269)	0.112 (0.242)	0.091 (0.342)	0.027 (0.782)	–0.018 (0.856)	–0.016 (0.872)

Notes: The predictor variables were entered into the model separately in the following order: sex, age, education, functional capacity, and depressive mood. Represented are B-coefficients with *P*-values in parentheses. Depressive mood by CPRS was split into two groups, 0–6 and 7–34 points, independence/dependence in ADL, age in groups 78–84 years and 87–93 years. Model 1 is the cognitive domain. Model 2 is the cognitive domain + sex. Model 3 is the cognitive domain + sex + age. Model 4 is the cognitive domain + sex + age + education. Model 5 is the cognitive domain + sex + age + education + ADL. Model 6 is the cognitive domain + sex + age + education + ADL + CPRS.
Abbreviations: LSI-A, Life Satisfaction Index A; CPRS, Comprehensive Psychiatric Rating Scale; ADL, activities of daily life.

Table 5 Pearson's correlation coefficients between the six cognitive domains at baseline and LSI-A at reexamination

	LSI-A	*P*-value
Executive abilities	0.116	0.010
Processing speed	0.153	0.001
Episodic memory	0.095	0.032
Semantic memory	0.033	0.445
Spatial abilities	0.161	<0.001
Working memory	0.048	0.269

Abbreviation: LSI-A, Life Satisfaction Index A.

LS in the oldest-old. Examples of such factors could be burden of symptoms, which has been shown to explain 14% of the variance in LS,[1] functional capacity, and depressive mood.[1,2] From a medical point of view, however, knowledge about the associations between cognition and LS might offer additional tools in an attempt to maintain LS in this patient group. The results of Wolinsky et al,[9] who trained a group of elderly individuals in processing speed and saw a remarkable reduction in the risk of developing depressive symptoms, underline the clinical possibilities in this area.

Processing speed is "the ability to automatically and fluently perform relatively easy or over-learned elementary cognitive tasks, especially when high mental efficiency (eg, attention and focused concentration) is required."[25] In our model (Table 4), one score higher on processing speed tests meant that LSI-A increased by 0.13 points. This domain is involved in processes such as driving and learning, as it involves perceiving stimuli and quickly being able to decide whether a given stimulus is important for the present situation or should be discarded. The connection to LS might be explained by the fact that impaired processing speed in the elderly could cause difficulties in the partaking of social and societal life.

Spatial ability has been defined as "the ability to generate, retain, retrieve and transform well-structured visual images."[26] Because of their high demands on working memory, spatial tests are usually recognized as good measures of general intelligence. Spatial ability has been associated with creativity in various fields: artistic, mathematic, and scientific. A person with more spatial intelligence is assumed to create richer images of spoken or written language, and he or she is thereby better able to see contexts and more subtle aspects of topics. This may partly explain the association to LS found in this study. The regression model (Table 4) shows that scoring higher by one point on spatial abilities corresponds to an increase in LSI-A by about 0.5 points.

A lower cerebrovascular burden in the oldest-old is associated with longevity, fewer depressive symptoms, and stable cognitive function.[27] Table 2 shows that the effect of certain cognitive tests (digit cancellation, comparing figures, mental rotations, and verbal fluency) remains in the healthy groups (ie, those not affected by hypertension, stroke, or dementia), meaning that the results are not based on a lower LS score due to effects of stroke or dementia per se.

In several of the cognitive tests, the correlations are higher for the group scoring higher on depressive mood (Table 2). This is probably an expression of the confounding effect of depressive mood on LS, even if there are still significant associations in the nondepressed group. Rabbitt et al[28] found that higher scores on a depression scale (though the scores still fell in the "healthy" realm on the scale) yielded lower performance on measures of Gf as well as Gc. This could also be reciprocal with lower cognitive abilities, making an individual more prone to depressive mood and lower LS.

Confounding effects were illustrated by the higher correlations between cognition and LS in the functionally impaired group (Table 3). It may be the case that the functionally impaired group is more dependent on cognitive abilities when overcoming the threat to LS that impaired functionality constitutes. A previous study on stroke patients revealed that active coping strategies at a 3-year follow-up were related to greater improvement in both quality of life and ADL.[29]

Education is a possible confounder since it has been shown to be associated to LS and cognition.[1,30] Cognitive abilities seem to affect LS more in those with higher levels of education (Table 3). This might reflect that a person with higher intelligence has built his/her life around relations and activities that demand higher intellectual capacities. However, after adjusting for education in the regression models, Gf still affected LS. Our results thus support those of Moore et al[30] who found positive correlations between cognitive performance and higher education, as well as between higher income and self-rated successful aging. For verbal fluency, the associations are much weaker for the group with lower education levels than for those with higher education levels. The verbal fluency tests are affected by education, and when the model is adjusted for education, the association between verbal fluency and LS is lost.

Impaired LS and cognitive decline have been shown to be a part of the concept of "terminal decline."[31,32] A potential weakness in this study is that age was measured as time from birth; adjusting for proximity to death might have diminished possibilities for confounding, making the association between Gf and LS weaker.

Contrary to results of Siedlecki et al,[10] we found associations between cognitive domains related to Gf and LS. Even if the elderly individual is retired in most cases and thereby does not face the ever-changing situations associated with work and career, this might reflect that the individual still has to be able to learn new things constantly to keep up with changes in society and to face new living conditions and perhaps diminishing physical capabilities that the aging body presents. The only test in our battery indicating Gc, the synonym-test, was not significantly associated with LS, just as in the results of Siedlecki et al.[10]

Many different instruments and different variants of these instruments are in use in this research area; therefore, data for specific cognitive tests were presented in this paper so as to make comparisons with other studies easier. To reduce the risk of statistical mass significance, the tests were categorized into cognitive domains in the final analysis.

The study population was large and randomly selected using the Swedish National Population Registry. No exclusion was made based on living conditions; home visits were made in almost every third case to reduce selection bias. Help with interpretation and filling in questionnaires was offered to people with language difficulties and other disabilities.

Attrition analysis showed that younger participants with higher scores on the LSI-A index and higher scores on the cognitive tests were those that continued on in the study; therefore, the generalizability of the results should be made with caution. However, a rather large attrition rate is common in studies that include the oldest-old.[13] Given that the majority of individuals lost to follow-up were those with lower LS and who presented with lower scores on the cognitive tests, it is likely that the attrition reduced the overall distribution, and as a consequence, the correlations noted in this study might be an underestimation of the true association.

Different definitions are used when it comes to the oldest-old, with some definitions drawing the line at age 80 years and some at 85 years. In the Good Aging in Skåne study, individuals aged 78 years and older are reexamined every 3 years, which is in contrast to younger participants who are reexamined every 6 years. To gain power in the study, we included those participants that would pass the age of 80 years during the 3 years between examinations.

In conclusion, fluid cognitive abilities (especially spatial abilities and perceptual speed) predict LS in the oldest-old. Several studies have shown that through training, fluid cognitive abilities can be enhanced to a significant and meaningful degree even in very old ages.[9,28] These findings perhaps implicate additional roads for professionals working with the oldest-old and seeking to preserve these individuals' LS.

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Author Contributions

All three authors contributed substantially to the design of the study as well as to analysis and interpretation of data. Å. Enkvist wrote the article, but all three authors took part in the writing process through critical revision and final approval of the manuscript.

Disclosure

The authors report no conflicts of interest in this work.

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