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Review

Aging in A Changing World – the Impact of Social Contact and Physical Activity on Health-Related Quality among Older People from Austria – A Biological Perspective

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Abstract

***Background*:** All over the world we are confronted with an absolute and relative increase in the proportion of older people. In order to develop strategies to keep older people healthy and independent as long as possible, analyses of factors influencing health related quality of life (HRQL) during old age are necessary. The aim of this review is to present the results of three projects carried out in Austria by the author focusing on the impact of social contact and physical activity on HRQL.

***Methods*:** The standardized WHOQOL BREF and the Geriatric Depression Scale was used to estimate HRQL and prevalence of geriatric depression in older Austrians. For the assessment of social network characteristics, a 50 item questionnaire was used. Physical fitness was estimated by hand grip strength and sarcopenia and bone loss were determined by DEXA measurements.

***Results*:** Higher face to face contact frequency and higher number of offspring increased HRQL and reduced geriatric depression. Sarcopenia and reduced bone density which might increase the risk of frailty syndrome were significantly interrelated.

***Conclusions*:** The ongoing change of life circumstances increase psychosocial problems such as loneliness and depression among older people who no longer live embedded in their

families. Childlessness and reduced contact frequency are related to health related quality of life during old age. This is also true of reduced physical activity in daily life, which increases the risk of sarcopenia and osteoporosis and may be invalid during old age.

Keywords
Human senescence; quality of life; social contacts; sarcopenia; osteoporosis

1. Introduction

Without any doubt, we are living in a rapidly changing world. Changing life circumstances and environmental change, however, are not new phenomenon of the 21st century. *Homo sapiens* and his ancestors had to cope with a lot of drastic environmental changes during their evolution and history. During the last 200 years and in particular during the last few decades, however, the tempo of change has increased dramatically. Besides the natural environment, the economy, demography, social lifestyles and population composition have undergone rapid transitions [1-3]. From the viewpoint of public health, changes in lifestyle patterns and social environments have a major impact on psychosocial situations and health related quality of life of people all over the world. All stages of life history, in particular old age, are affected.

One major determinant of the challenges associated with these changes is the marked change in population structure which is one hallmark of recent change. There is near certainty that we will be confronted with rapid population aging in many parts of the world during the next decades. In industrialized high income countries, population aging has been an ongoing phenomenon since the second half of the 20th century. While the proportion of people older than 65 years is increasing steadily, the amount of children and adolescents (< 15 years) is decreasing. This trend is mainly due to widespread reduction of birth rates in combination with prolonged life expectancy [2, 4]. This change in population structure represents a special economic and social challenge for families, societies, and states, who have to provide pensions, public health facilities, and care for a huge number of old and possibly dependent or disabled persons. Furthermore, during the second half of the 20th century our individual lifestyles have changed dramatically. These changes in lifestyle patterns, which include declining birth rates, increasing numbers of single households, decreasing relationships between family members, increased mobility but also reduced physical activity in subsistence and daily life, have an impact on the process of aging and senescence [5, 6]. The benefits of advances in medical science and health treatment are reduced by psychosocial problems among older people, such as loneliness, dependence on institutional support, and fear of helplessness.

This review focuses on the impact of psychosocial factors associated with changes in family composition and social contact, but also reduced physical activity on health related quality of life during old age, with special respect to the situation in Austria.

2. Aging and Senescence in Evolution and History

This review focuses on the situation of older people in Austria from the viewpoint of biological anthropology. The topic of this review is biological aging. Considering this viewpoint, we have to state that aging is not a disease, it is a part of human life history and means nothing else other than the phenomenon of becoming older [7]. Consequently, aging is a biological process which started with conception. With increasing age the process of aging, however, is associated with senescence, which is characterized by a gradual functional decline, causing progressive deterioration over time. Senescence thus leads to an increased probability of morbidity and mortality [7]. With increasing age, the ability to respond to stress decreases, while homeostatic imbalance increases. Consequently, old age is associated with an increased risk of several non-communicable diseases such as osteoarthritis, osteoporosis, sarcopenia, cardiovascular disease, cancer, dementia, and diabetes type 2 [8, 9]. Aging and senescence are therefore major causes of suffering, disease, reduced health related quality of life, and even death in modern times.

Although the proportion of older people is currently increasing, aging and senescence are not new phenomena of the 20th and 21st centuries [10, 11]. There is abundant evidence that since Paleolithic times some individuals lived to ripe old ages even while senescence related functional impairment took place at younger ages than today. The famous Neanderthal specimen ace atpo-called oday.Man of La Chapelle aux Saintshapelle auamous Neanderthal specimen ace atporosis, sarcopenia, cardiovascu [12]. There is also evidence from the Middle Pleistocene site of Sima de los Huesos (Spain) of an approximately 45 year old male Homo heidelbergensis who lived more than 500,000 years ago who suffered from painful age related changes to his lumbar column [13].

Age related diseases which reduced health related quality of life drastically were well known in ancient times. The Roman philosopher Seneca (1-65 AD) described wold age as an incurable diseaseed health related quality of life drastically were well known in ancient times. The Roman philosopher Seneca (1-creased mobilitye is near certainty that we will be confronted with rapid populat, which incre children or other relatives. Athenian law required that children care for their aging parents and neglecting disabled parents was punished by the loss of citizenship. Senior care was ultimately the responsibility of the eldercreased mobilitye is near cert did not change much for nearly 2,000 years [14]. Although it is unlikely that many individuals survived sufficiently long enough to become old by current standards, age related diseases as well as social and economic problems of old age were well known during medieval and early modern times. Consequently, the idea of a to become old by c as painted by Lucas Cranach the Elder in 1546, which makes old people young and beautiful again, became an eternal dream. To care for old and disabled persons was still exclusively the duty of relatives up to the 19th century.

During the 19th century governments in Europe and North America came to realize that they had some sort of obligation to ensure that indigent seniors at least had somewhere to live and something to eat. Consequently, so called urrent y the responsibility of the eldercreased mobilitye is near certainty that we will be confronted with rapions were intended to be charitable, workhouses or poorhouses were rather awful places to live. The old people were segregated by sex, forced to wear uniforms, and - if feasible - required to participate in work to upkeep the property. Around 1900, about 10% of older people lived in workhouses in England [15]. These common experiences of helplessness and poverty during old age contributed to the negative view of aging and senescence up to recent times.

Today, many people are still afraid of becoming old and of the consequences of senescence. Consequently, Jonathan Swift's assumption that "everybody wants to live forever, but nobody wants to grow old" seems still to be true for many nowadays.

3. Aging in A Changing World

The increasing proportion of older people is increasingly seen as a major social and economic problem all over the world. A longer life expectancy coupled with a dramatic decline of birth rates has resulted in the rapid aging of populations in most parts of the world during the last decades, and this process is ongoing. This trend started in Europe. In 1950, only 12% of the European population was over age 65. Today the share has already doubled, and projections show that in 2050 more than 30% of Europeulation/publications/worldageing19502050" as already doubled, and er life expectancy coupled with a dramatic decline of birth rates has resulted in ill b, and Japan show high rates (up to 25%) of older inhabitants. This trend is projected to continue for the next decades, but also for rising middle income countries such as China, India, and Brazil. In 2015, 8.5% of the world population was older than 65 years. In 2050, the demographic change towards a high proportion of people older than 65 years will affect many middle income countries and will provide these societies with never experienced challenges [16].

What are the reasons for this trend? The culprits are longevity and fertility rates. On the one hand, advances in medical science and health care, the end of famine and starvation in many parts of the world, and long periods of peace have contributed to the increase of life expectancy in first world countries. Consequently, Europeans are living longer, 78 years on average, up from 66 years in the 1950s. On the other hand, birth rates dropped down during the 20th century. In the past, a woman in Europe had on average more than two children. During the last 50 years, the fertility rate has fallen below the replacement level. This trend is mainly due to the development and availability of safe contraceptives, prolonged phases of education, and increasing levels of occupation of women and general female emancipation. Consequently, prolonged human life span and low fertility rates are interpreted as signs of Europeves, prolonged phases of educationh a dramatic decline of birth rates haaging society is also creating an array of social and financial problems for the continent. Considering that in the near future many populous middle-income countries will follow this trend, we really have to speak about aging using economic, social, and psychosocial lenses [17, 18].

A typical example of this trend is China, the worlduntries will follow this, which is in a transition to an aging society [18, 19]. Dramatically decreasing birth rates, the result of the one-child policy, and dramatically improved life expectancy mean that by 2050 more than a quarter of Chinacally improved life expectancy mean that by 2050ond as sign [16, 20].

According to the Global Age Watch Index, the situation of older people without adequate support from their relatives is worse in middle and low-income countries or countries confronted with wars, such as Afghanistan, which ranked at the bottom of the Global Age Watch Index for many years [21]. In general, older persons in middle and (in particular) low income countries are confronted with poverty, starvation, malnutrition, and homelessness. The few homes for old people are often awful places, as those in Europe in former days.

Therefore, we are clearly confronted with a huge amount of problems associated with an aging society in many parts of the world. In order to cope with this challenge, intensive scientific

analyses are absolutely necessary. Up to now, the phenomenon of population aging was predominantly focused from a demographic and socioeconomic viewpoint. This kind of research was motivated by a sense that existing public policies must be changed in order to cope successfully with the projected aging of the population [3]. Population aging, however, is not only a social or economic challenge; it represents also a biomedical and psychosocial problem [7, 22, 23]. Besides well documented physical impairments such as osteoporosis, sacropenia, degenerative arthritis, metabolic symptoms, or tooth loss, there are age typical psychosocial problems, such as loneliness and geriatric depression, which contribute to the well described reduction of well-being, poor health, and consequently reduced health related quality of life among older people [24-27].

Considering these future trends and facing the problems that will arise from aging societies, our main goal should be - beside economic actions - to keep old people healthy, physically active, and independent as long as possible to maintain a high health related quality of life.

4. Viennese Aging Projects

From a scientific viewpoint, lots of studies have been carried out in order to analyze the various problems of an aging society. During the last 20 years the Department of Evolutionary Anthropology at the University of Vienna conducted three large projects, “Optimal Aging” (1999-2003), “Childlessness in Old Age” (2004 to 2007), and “Age Related Body Composition Changes and its Impact on Public Health” (2008 to 2014), focusing on the situation of older people in Austria from a multidisciplinary viewpoint.

4.1 Population Structure in Austria

Currently, Austria is clearly a graying society. Life expectancy at birth has increased steadily during the 20th century. During the last 30 years marked increase of life expectancy of men and women occurred and this trend is predicted to continue during the next decade. It is estimated that life expectancy at birth will increase to 86.3 years for women and to 81.9 years for men in 2030 (Figure 1).

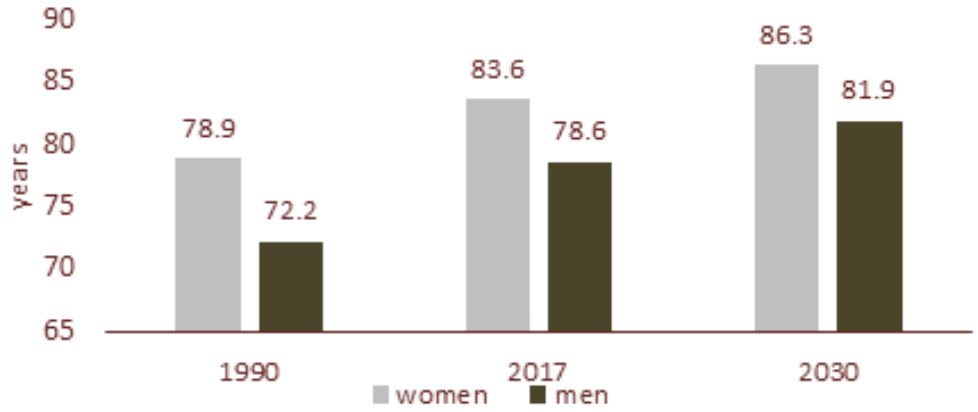

Figure 1 Life expectancy in Austria (Source: Statistik Austria, 2018 [28]).

Besides the increase of life expectancy, the population structure in Austria has changed during the last 150 years. Since 1869, the year of the first population census in Austria, the percentage of juvenile persons aged up to 15 years dropped down from about 28% in 1869 to 14.4 % in 2017. In contrast, the proportion of older persons aged 65 years and above increased from 5.2% to 18.5%. Consequently, as demonstrated in Figure 2, people older than 65 years outnumbered individuals younger than 15 years during the last ten years [28].

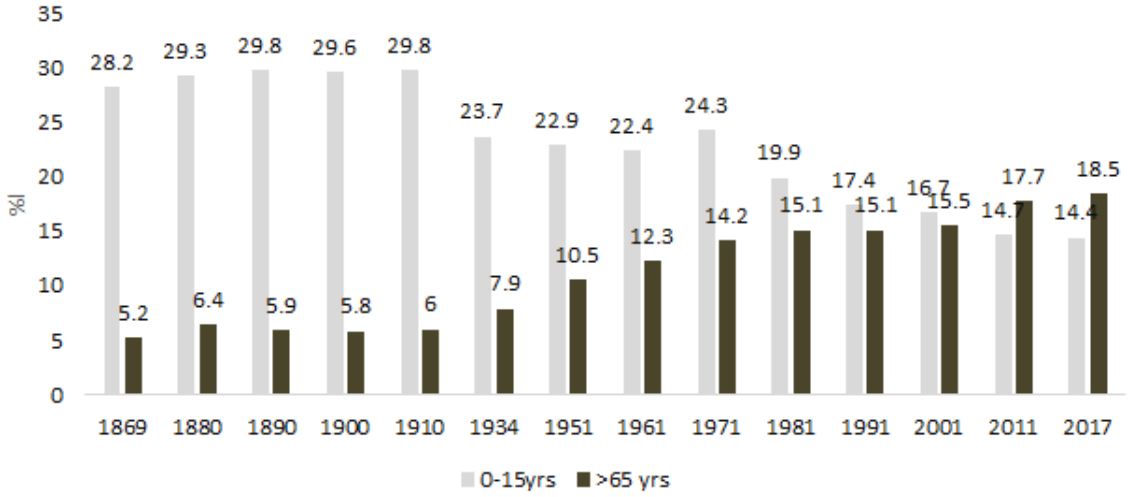

Figure 2 Population structure in Austria since 1869 (Source: Statistik Austria 2018 [28]).

As demonstrated in Figure 3, during the same period (1869 to 2017) the percentage of persons aged 85 years and older increased from 0.1% to 2.6%.

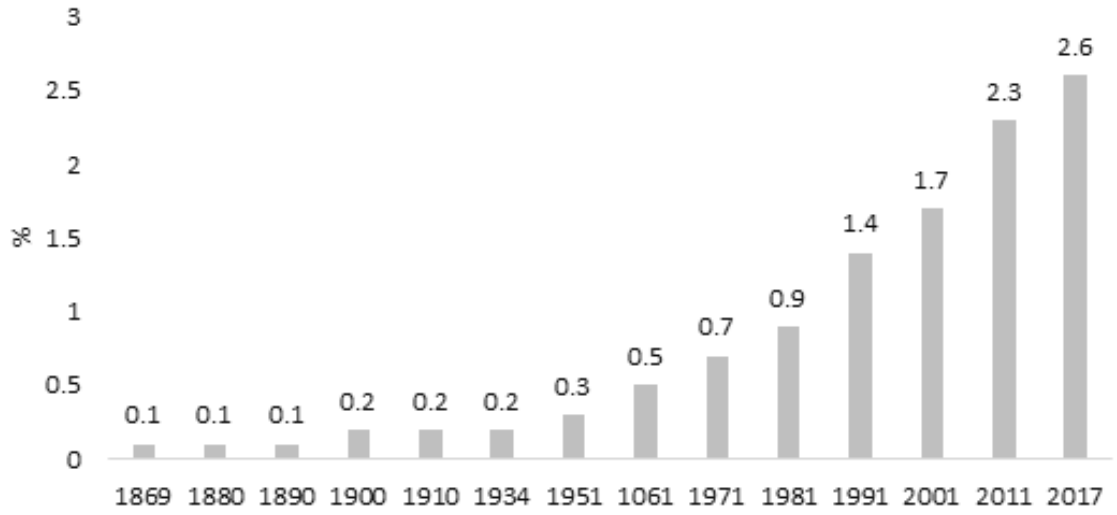

Figure 3 Population aged 85 years and above in Austria since 1869 (Source: Statistik Austria 2018 [28]).

In addition to the increasing life expectancy, the average number of offspring per woman dropped down in Austria during the last 60 years, from 2.8 children per woman to 1.3 in 2015. Figure 4 shows clearly that the fertility rate dropped below the replacement level since the early 1970s.

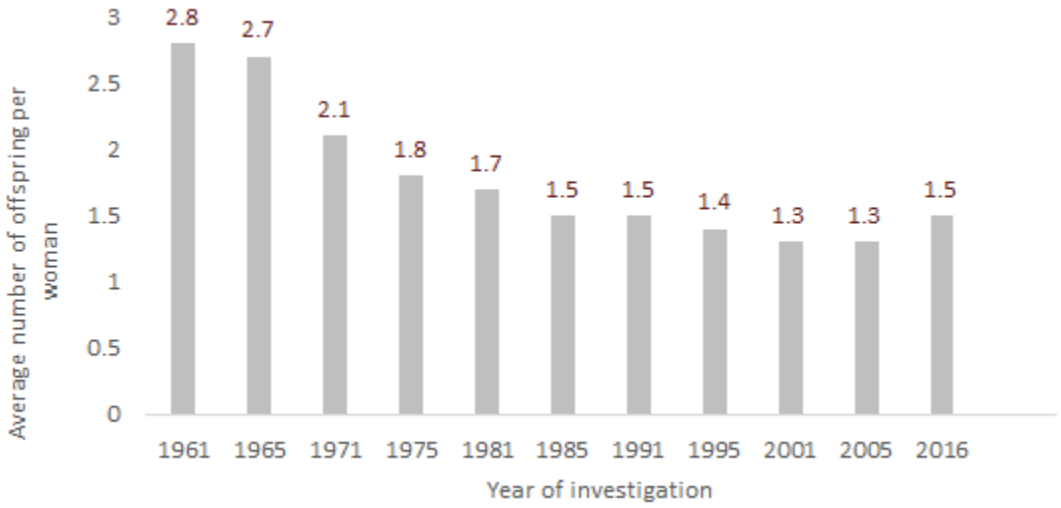

Figure 4 Average number of offspring per woman in Austria between 1961 and 2016 (Source: Statistik Austria 2018 [28]).

4.2 Social Contact and Health Related Quality of Life

Up to the second half of the 20th century, old people have been important parts of the extended family and society in Austria. Especially in rural areas, old people lived together with their families in the same household. On farms, they may have done some subsistence work, took care of children, and held collective memories, because their rich experiences might help their relatives in times before Google. Today, old people live only in rare cases together with their children and grandchildren in one household. There is a steady migration from rural areas to urban centers. Urbanization had a major impact on household composition and the living situation of young and old people. The majority of older people live alone, sometimes far away from their offspring and other relatives. The frequency of face to face contact with relatives has decreased drastically. Consequently, old people are confronted with loneliness, social isolation, and dependence on professionals or non-related people. Furthermore, there is a recent trend of single households and voluntary childlessness in many high-income countries [29].

In one of the Viennese projects (vChildlessness in Old Age”g the impact of the number of offspring, contact frequency with relatives, and childlessness on health related quality of life was tested among 150 independent living men and women aged between 60 and 94 years in Vienna, Austria [30, 31]. Health-related quality of life (HRQL) is a multi-dimensional concept that includes domains related to physical, psychological, social, and environmental parameters. In the present project, the WHOQOL BREF version of the WHOQOL was used [32, 33]. Additionally, the German version of the 15 item Geriatric Depression Scale [34] and specifically developed questionnaires regarding reproductive history, number of offspring, and contact frequencies, were used.

Table 1 demonstrates that childless persons showed the lowest significant levels of HRQL in the psychic, social, and environmental domains, thus overall reflecting the lowest composite HRQL. The highest significant scores were found for subjects with 3 or more children.

Table 1 Number of children and health related quality of life (Source: Kirchengast & Haslinger 2008, 2015 [30, 31]).

HRQL domain	Number of children No child mean (sd)	1 child mean (sd)	2 children mean (sd)	⩾ 3 Children mean (sd)	Significance p-value
n	25	29	66	22	
Global	15.5 (2.8)	15.5 (2.9)	15.5 (2.8)	16.1 (2.1)	0.899
Physical	16.1 (2.7)	15.5 (3.3)	16.3 (2.7)	16.8 (2.2)	0.537
Psychic	15.1 (2.2	15. 5 (1.9)	15.9 (1.7)	16.7 (1.9)	0.024
Social	15.3 (2.3)	15.6 (2.8)	16.6 (2.1)	16. 4 (2.6)	0.048
environment	16.5 (1.9)	16.6 (1.9)	17.2 (1.6)	17.7 (1.9)	0.049

Furthermore, a significant positive association between health-related quality of life and offspring contact frequency was found (Table 2). In other words, the higher the contact frequency, the higher health related quality of life. Contact means face to face contact.

Table 2 Correlations between individual domains of WHOQOL-BREF and offspring contact frequency per month (parents with at least 1 child) (source: Kirchengast & Haslinger 2015 [30]).

QL Domain	global	physical	psychic	social	environment
Contact frequency to offspring	0.28**	0.20*	0.21**	0.28***	0.19*

* p <0.05; ** p <0.01; *** p <0.001

Geriatric depression is a common phenomenon among elderly people in many high income countries. In the Viennese project, geriatric depression score was correlated with the number of offspring and contact frequency with relatives. Although only 12% of the men and women showed signs of mild geriatric depression according to the geriatric depression scale, depression scores were significantly positively associated with chronological age, and significantly negatively associated with the number of children, grandchildren and great grandchildren, and with contact frequency. In other words, the higher the number of offspring and the higher the face to face contact frequency, the lower the depression score (Table 3) [35, 36].

Table 3 Impact of number of offspring and intergenerational contacts on depression score (Regression analyses) (source: Kirchengast & Haslinger 2008 [35]).

Dependent variable: depression score	coefficient	p-vale	95% CI Interval
age	0.07	0.001	0.03 – 0.11
Number of children	-0.25	0.01	-0.48- -0.03
Number of grandchildren and great grandchildren	-0.18	0.03	-0.23 – -0.01
Number of contacts to children per month	-0.12	0.04	-0.76 – 0.42
Number of contacts to offspring (children and grandchildren) per month	-0.11	0.05	-0.41- 0.42

4.3 Reduction of Physical Activity

Another aspect of lifestyle change which might affect health related quality of life during old age is the reduction of daily physical activity which may result in low bone density, decreased skeletal muscle mass, and may be in the occurrence of the frailty syndrome. From an evolutionary viewpoint, *Homo sapiens* has adapted to a high level of physical activity [37]. Our ancestors and even the few remaining hunter gatherer populations today followed a typical forager subsistence which is characterized by a high level of physical activity, especially daily walking of long distances even in old age. With changes in subsistence patterns, daily physical activity levels decreased. During the 20th century physical activity levels dropped dramatically. A comparison of physical activity levels known as PAL (in 24 hours, total energy expenditure (TEE)/basal metabolic rate (BMR)) of recent foragers, agriculturalists, and those living in modern societies clearly demonstrates that in modern societies the average physical activity level corresponds to the definition of sedentary behavior (PAL below 1.7), while in various traditional societies of different subsistence patterns, the mean PAL is between 1.8 and 2.3, indicating a highly physically active lifestyle. Modern people clearly perform at a low physical activity level [38]. Figure 5 demonstrates the physical activity levels (PAL) according to different subsistence patterns.

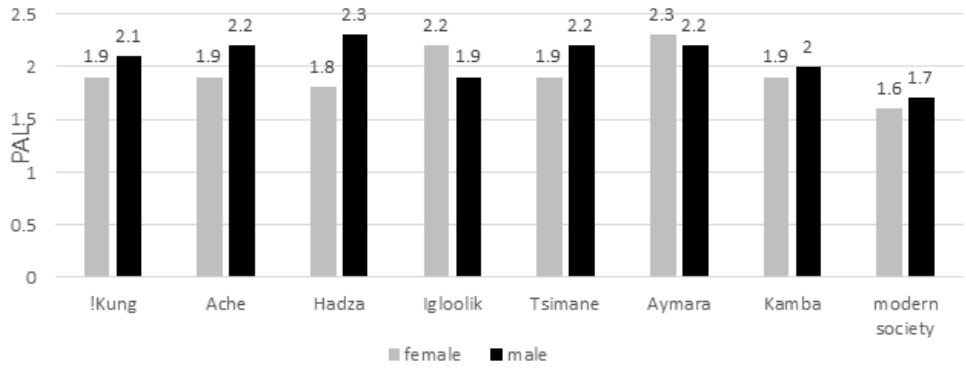

Figure 5 Physical activity levels (PAL) among recent foragers, agriculturalists and modern societies (source: Kirchengast 2014 [38]) PAL = TEE in 24h/BMR.

Up to the middle of the 20th century, especially in rural areas, physical work load was high even among older people in Austria. During the last decades, physical activity patterns changed dramatically. Today, daily life in Austria – as typical of modern industrialized societies - is characterized by an exceptionally low rate of physical activity. Lifestyle patterns in rural as well as urban environments have diminished physical activity, and there is no possibility of turning the wheel back. Physical effort in work and occupation has decreased steadily. Cars, public transportation, elevators, internet shopping, and the trend of cocooning promote a sedentary lifestyle. As typical of all industrialized countries, people show a mainly sedentary behavior, working with their fingertips and spending leisure time by watching TV or surfing in the internet [39]. This trend of a life time of reduced physical activity in combination with an enormous and omnipresent surplus of tasty food rich in refined sugars and unsaturated fat results in increasing rates of obesity. This in turn enhances the prevalence of many non-communicable diseases such as such as diabetes mellitus type 2, cardiovascular issues, hypertension, hypercholesterinemia, and cancer, and also diseases of the musculoskeletal system such as osteoporosis and sarcopenia

[40-42]. Additionally, physical inactivity is associated with various psychological problems and neurological syndromes such as dementia [43, 44].

In our project "Age related body composition changes and its impact on Public Health" we analyzed age related changes in body composition and in particular, the association between decreasing bone mass/density and skeletal muscle mass.

It is well documented that human body composition changes through the process of aging [45]. Besides general weight gain, two significant alterations are observable. On the one hand there is a shift towards more body fat mass, especially the accumulation of abdominal fat deposits and visceral fat mass; on the other hand, there is a gradual loss of skeletal muscle mass and bone mass/density [46, 47]. These body composition changes start relatively early, in the third and fourth decades of life, and continue up to old age [48]. While the adverse health effects of an increase in fat mass often in combination with the development of obesity and progressive bone loss resulting in osteopenia and osteoporosis [49] have been well known for a long time [50], the dramatic disabilities associated with the gradual reduction of skeletal muscle mass have been discussed only for about thirty years [51]. The term sarcopenia, from the Greek "poverty of flesh," was introduced by Rosenberg in 1989 [52]. The progressive loss of skeletal muscle mass is considered one of the hallmarks of the human aging process [53]. Sarcopenia is characterized by the degenerative loss of skeletal muscle mass (0.5sideredduction of skeletal muscle mass muscle atrophy (a decrease in the size of the muscle), reduction in muscle tissue quality, changes in muscle metabolism, and degeneration of neuromuscular function, consequently leading to progressive loss of muscle function [54, 55]. Consequently, sarcopenia is strongly associated with increased physical disability, vulnerability, and the frailty syndrome [56-58]. Frail old people have not only an increased tendency to fall but also to break bones due to these falls and so sarcopenia results often in helplessness and in the loss of independence [59].

In our project the data of 1,925 Austrian women aged between 19 and 94 years were analyzed. Body composition and bone density were determined by DEXA measurements. For the classification of sarcopenia the definition proposed by Baumgartner et al [58] was used, i.e. an adjusted ASM (RASM) greater than 2 standard deviations below the sex specific mean from a young healthy reference population was classified as sarcopenia. Normative levels for adjusted ASM (RASM) were taken from Gallagher et al. [56] for white non-Hispanic Caucasians.

As seen in Table 4 bone mass (BMC), bone density (aBMD), lean body mass i.e. skeletal muscle mass, and appendicular skeletal muscle mass (ASM) decrease significantly with increasing age [60]. This is a normal age related change.

Table 4 Bone mass, bone density, and lean body mass according to age (Source: Kirchengast & Huber 2010 [60]).

	30-50 years mean (sd)	51-60 years mean (sd)	61-75 years mean (sd)	>75 years mean (sd)	p-value
BMC total (kg)	2.3 (3.2)	2.2 (2.9)	2.1 (3.4)	1.8 (2.9)	<0.001
aBMD total (g/m^2)	1.111 (0.088)	1.092 (0.092)	1.037 (0.109)	1.002 (0.079)	<0.001
Lean body mass (kg)	40.8 (5.2)	40.5 (4.4)	39.9 (5.5)	38.3 (3.8)	<0.008
ASM (kg)	16.3 (2.6)	16.1 (2.3)	15.8 (2.6)	14.9 (1.8)	<0.005

BMC = bone mineral content, aBMD = bone density, ASM- Appendicular skeletal muscle mass

Concerning skeletal muscle mass and bone density a significant age related decrease occurred. The prevalence of sarcopenia increased significantly with increasing age and decreasing bone density (see Figure 6) [60-62].

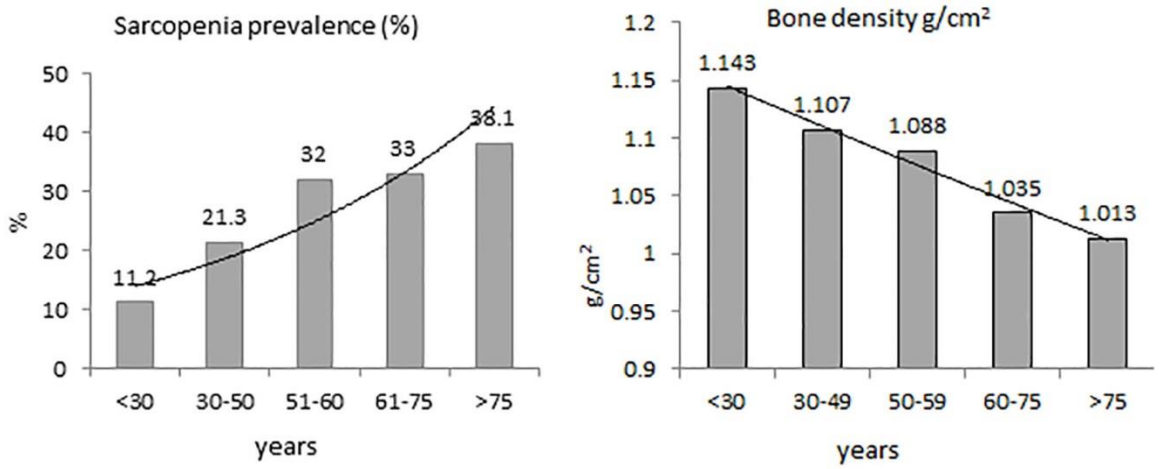

Figure 6 Sarcopenia and bone density (g/cm^2) according to age group (Source: Kirchengast & Huber 2009, 2010 [60, 62]).

Figure 7 presents the comparison between sarcopenic and non-sarcopenic women of different age groups. Bone density was significantly lower in sarcopenic women than in non-sarcopenic ones [63].

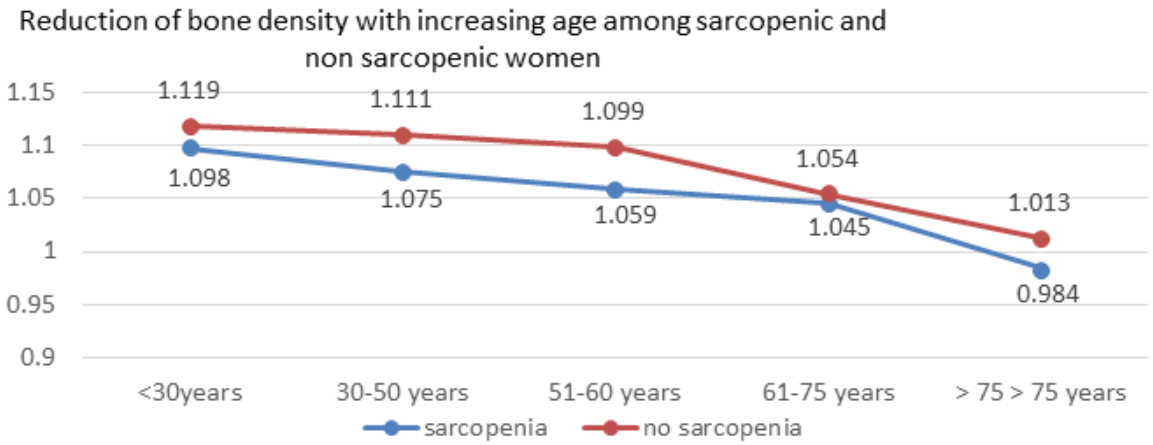

Figure 7 Bone–Boneeopenic a Source: Kirchengast &Huber 2010 [60].

In a recent study the effects physical fitness, estimated by hand grip strength, on health related quality of life among a small group of 63 healthy independent men and women aged between 60 and 94 years was tested (Table 5). Health related quality of life was estimated by self-reporting based on the questionnaire of WHOQOL BREF [32, 33]. A significant positive association between hand grip strength, an indicator of physical fitness, and health related quality of life, could be documented [64].

Table 5 Impact of hand grip strength (HGS) on HQL domains multiple regression analyses p <0.05, ** p <0.01 (Source: Musalek & Kirchengast 2017 [64]).

HQL domain	global β	physical β	psychic β	social β	environment β
HGS dominant hand	0.14*	0.12*	0.04	0.04	0.17*

To sum up the results of this project, the prevalence of sarcopenia increased with increasing age and was quite high among older people. Furthermore, a significant association between reduced bone density and sarcopenia could be proved.

5. Discussion

Population aging is a global phenomenon of the 21st century. In Austria, the proportion of people older than 65 years increased steadily during the 20th and 21st centuries. The recent dramatic increases in the population of the old and the very old make the maintainance of health-related quality of life challenging for the government and the public health system, and also for families and individuals. Consequently, the scientific analysis of factors influencing health related quality of life during old age is of special importance. Health related quality of life among older people is influenced by several endogenous and exogenous parameters [25, 26, 30, 65-70] such as psychosocial factors and also physical fitness [71]. Among the most important psychosocial factors influencing health related quality of life are social networks and especially intergenerational contact. Both enhance wellbeing and health related quality of life during old age [30, 72-76]. Dramatic changes in family structure and also weakened relationships between older parents and their adult children affect health related quality of life in an adverse manner. This association was also found for the old Austrian people in the projects presented in this review [30, 31, 35, 71]. Population change, the increasing weakness of social relationships, and increasing rates of voluntary or involuntary childlessness add burdens to families and welfare systems, the two major pillars of support in old age [76, 77]. Since the 1970s, the quality and quantity of social relationships, especially between close relatives, have been increasingly recognized as risk factors for morbidity and mortality and also for health related quality of life and subjective well-being during old age. Several studies indicate the generally positive effects of social support and family membership on health and survival during old age [19, 78-85]. These findings were supported by the results of the Viennese projects.

Besides these social factors, lifestyle changes characterized by decreased daily physical activity has dramatic consequences for physical fitness, skeletal muscle mass, and bone density, resulting in sarcopenia and osteoporosis in the worst case [30, 49]. Skeletal muscle mass and bone mass as well as bone density are interrelated. This bone-muscle relationship is mainly viewed in the context of the mechanostat theory [86, 87] and the theory of the functional muscle bone unit. Bones and skeletal muscle respond to varying mechanical strains modulated by systemic effects such as hormones. Consequently, a decrease of daily physical activity results in accelerated bone loss and muscle atrophy. In the worst case, osteoporosis and sarcopenia are the results of a sedentary life style. Bone loss and muscle atrophy are interrelated; both share a common embryogenesis and are regulated and controlled by the same hormones and genes throughout life

[88, 89]. Therefore, age related decreases of bone density and the decline of skeletal muscle mass are two sides of the same coin [89-91]. The results of the Viennese projects support these results [60-64, 92].

Reduced life time physical activity increased the risk of developing osteoporosis and sarcopenia [92] and consequently the so called frailty syndrome, which is characterized by severe unintended weight loss of >5kg/year, slow walking speed, muscle weakness, self-reported exhaustion, and low levels of physical activity [93]. Frailty often results in immobilization, an increased fracture risk, and an increased risk of permanent invalidity [94-97].

It seems absolutely necessary to increase physical activity during one's life time to reduce the tempo of sarcopenia and bone loss during the aging process [98]. Unfortunately, *Homo sapiens* tend to avoid physical activity. This behavior of avoiding physical activity may contribute to reduced health related quality of life during old age. Considering the typical life style patterns of recent *Homo sapiens,* it is important to increase physical activity during leisure time. This is a quite young activity pattern in the history of *Homo sapiens.* Our ancestors had no desire for physical activities; they had to move to survive. We are born to move, to walk, to run and now we have to incorporate these kinds of activities into our leisure time behavior. For the first time in our evolution and history we have to be physically active not to seek shelter or food, but to maintain health related quality of life during old age. This is a completely new challenge for *Homo sapiens*.

6. Conclusions

We can conclude that we are living in an aging society. The ongoing change of life circumstances seems to increase loneliness and depression among old people who no longer live embedded in their families and consequently reduces health related quality of life. In addition, reduced physical activity in daily life increases the risk of sarcopenia and osteoporosis and may lead to invalidity during old age.

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S.K. wrote this review.

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Competing Interests

The author has declared that no competing interests exist.

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