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Alcohol and aging:

A longitudinal study of alcohol habits and health effects due to alcohol consumption in old adulthood

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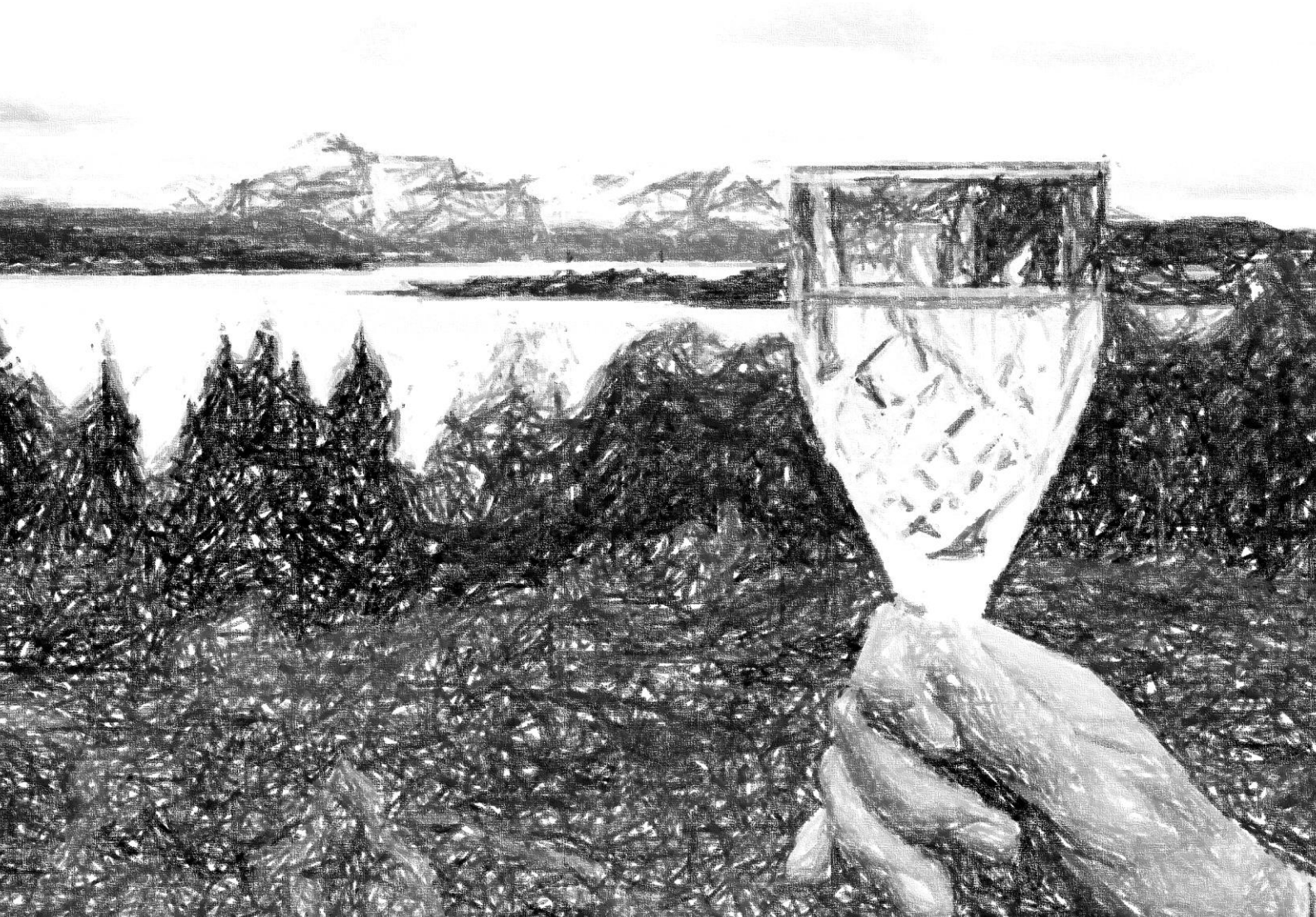

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Foreword

When I first started my clinical practice in an inpatient psychogeriatric ward in 2011, I had just been working as a senior consultant in an inpatient ward for younger adults struggling with comorbid alcohol, drug and psychiatric disorders. At that time, it was already established a consensus that comorbid psychiatric disorders and substance abuse disorders caused complications that did not occur when the health problem being treated was limited to a single disorder. There had also recently been published professional guidelines for the treatment of dual-diagnosis disorders in Norway [1]. However, older adults were not mentioned in these guidelines. As I continued to work in the field of geriatric psychiatry, I realized that even older adults cope with difficulties in less appropriate ways, such as misusing sedatives or alcohol. This made me curious as to why I had an assumption that older adults rarely drank alcohol, or that they at least only drank very small amounts on special occasions, and especially not if they had severe health problems. I questioned whether the alcohol habits that I thought existed among older adults might have changed over the past decades.

In 2013, our ward participated in a pilot study to examine patients' self-reported use of alcohol and prescribed psychotropic drugs [2]. We found that a proportion as large as 35% of the older inpatients scored above the cut-off for potentially risky alcohol use. We also suggested that there was a need for further research on what were the risk factors for increased alcohol use among current older adults. Since the inhabitants in our region had been participating in a large population-based study since 1974, an idea arose to apply for funding and access to data from this study [3]. My interest was to investigate whether alcohol habits had changed among older adults, and if so, would we be able to identify the "typical" drinker among the current generation of older adults, and further, were there any major adverse health consequences involved?

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I wish to thank my main supervisor Ole Kristian Grønli for encouraging me and giving me the chance to start this PhD journey. I'm sincerely grateful for your knowledge, insight, and inspiring advice during these three years. In addition, your friendly and calm attitude has given me safe support along the way and has helped me find solutions in times where I have struggled.

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Tromsø, July 2022,

Line Tegner Stelander

Abbreviations

ADH: Alcohol Dehydrogenase
APC: Alcohol Per Capita
ALDH2: Acetaldehyde Dehydrogenase 2
AUDIT: Alcohol Use Disorders Identification Test
AUDIT-C: Alcohol Use Disorders Identification Test-Consumption, consists of the first three items from the AUDIT regarding consumption
AUDIT-P: Alcohol Use Disorders Identification Test-Problem, consists of items 4-10 from the AUDIT regarding any problem due to alcohol consumption.
AUDIT-3: Consists of the third item of AUDIT-C (6+ units in one occasion).
BAC: Blood Alcohol Concentration
DAG: Directed Acyclic Graph
CI: Confidence Interval.
CONOR-MHI: Cohort Norway-Mental Health Index
EBM: Evidence-Based Medicine
FHI: Folkehelseinstituttet (National Institute of Public Health)
G: Grams
GABA: γ-aminobutyric acid
GEE: General Estimating Equations.
HED: Heavy Episodic Drinking (6+ units in one session)
HR: Hazard Ratio
HSCL-10: The Hopkins Symptom Check List-10
NIAAA: The US National Institute on Alcohol and Alcoholism
NorLAG: Norwegian Life Course, Ageing and Generation Study
OR: Odds Ratio
PPI: Patient and Public Involvement
REK: Regional Committee for Medical and Health Research Ethics
SPSS: Statistical Package for the Social Sciences.
SRH: Self-Rated Health.
WHO: World Health Organization.

List of papers

This thesis is based on the following papers:

Paper I

Stelander LT, Høye A, Bramness JG, Selbæk G, Lunde LH, Wynn R, Grønli OK. **The changing alcohol drinking patterns among older adults show that women are closing the gender gap in more frequent drinking: the Tromsø study, 1994-2016.** Subst Abuse Treat Prev Policy. 2021 May 26;16(1):45. doi: 10.1186/s13011-021-00376-9. PMID: 34039389; PMCID: PMC8152329.

Paper II

Stelander LT, Høye A, Bramness JG, Wynn R, Grønli OK. **Sex differences in at-risk drinking and associated factors-a cross-sectional study of 8,616 community-dwelling adults 60 years and older: the Tromsø study, 2015-16.** BMC Geriatr. 2022 Mar 1;22(1):170. doi: 10.1186/s12877-022-02842-w. PMID: 35232388.

Paper III

Stelander LT, Lorem GF, Høye A, Bramness JG, Wynn R, Grønli OK. **The effects of exceeding low-risk drinking thresholds on self-rated health and all-cause mortality in older adults: The Tromsø study, 1994-2020.** [Submitted April 2022, Archives of Public Health].

Summary

BACKGROUND / AIMS: Alcohol use is a leading risk factor for injuries, mortality and the burden of disease. Historically, alcohol consumption has been very modest in older adults. However, alcohol consumption varies considerably, depending on factors such as age, social class, education, ethnicity, and geographical setting. The overall aim of this thesis was to investigate trends in alcohol consumption and associated factors among older adults from the same geographical setting across 25 years, and any health effects due to alcohol consumption.
METHODS: Participants aged 60–99 when attending the Norwegian population-based Tromsø4-7 (1994-2016) were included. Sub-study used GEE to analyse trends in alcohol consumption (n=20,939). Sub-study II was a cross-sectional study based on Tromsø7 (n=8,616). Sex-stratified logistic regressions were used to assess associations between three at-risk drinking outcome variables, and sociodemographic and selected health characteristics. Sub-study III used an accelerated longitudinal design with multilevel random-effects models and Cox proportional hazard models (n=24,590). Primary outcome measures were self-rated health and all-cause mortality. Data were retrieved from the Norwegian Cause of Death Registry. The follow-up time extended from the age of study entry to the age of death or end of follow-up on November 25, 2020.
RESULTS: The overall abstinence rate decreased considerably between 1994 and 2016, from 31 % to 11 % (14 % in women and 7 % in men). The probability of reporting frequent drinking increased 6-8-fold in women compared to 3-4-fold in men. The overall prevalence of at-risk drinking was equal in women and men in Tromsø7; 44 % and 46 %, respectively. At-risk drinking was associated with very good health, living with a spouse or partner, and having adequate social support in women, while it was associated with the use of sleeping pills in men. We found that women, but not men, who consumed ≥ 100 g / week had better self-rated health than those who consumed < 100 g / week (OR 1.85, 95 % CI 1.46-2.34).
CONCLUSIONS: Alcohol consumption has increased considerably from 1994 to 2016 among Norwegian older adults. Our findings indicate that women's drinking patterns are approaching those of men. So far there is no definite evidence of increased mortality in the heaviest drinkers, as their balanced risk factors appear to be beneficial. However, we conclude that our findings imply that a change in governmental strategies and alcohol policy to influence alcohol consumption among older adults should be considered.

Introduction to alcohol and aging

Alcohol use in the context of aging is an under-researched area in European countries, and there are significant knowledge gaps in several countries [4, 5]. The population of older adults is increasing rapidly across Europe, including in Norway, and the number of people above the age of 65 years is estimated to double by 2050 [6]. Although older adults in European countries drink in less hazardous ways compared with younger adults, alcohol-related hospital admissions and alcohol-related deaths among older adults have increased over the past two decades [4, 7, 8]. As a response to health expenditure and social concerns due to demographic change, "active" and "healthy" aging has emerged as a political strategy [9-12]. The World Health Organization defines healthy aging as "the process of developing and maintaining the functional ability that enables wellbeing in older age" [13]. There is a growing need to focus on health maintenance and by identifying modifiable risk factors for poorer health, the opportunities for health promotion, interventions and prevention of health damage can be increased. Alcohol consumption is a leading risk factor for injuries, mortality and the burden of disease [14-16]. Previous research shows that older adults have decreased alcohol consumption as they age, and men have had more harmful drinking habits than women, including more frequent drinking and consumption of larger quantities [4, 17-19]. Although the research on alcohol consumption among older adults in Europe is still scarce, it has been reported that alcohol habits among older adults have changed in many developed countries in recent decades; more specifically, alcohol consumption has increased [20-26]. In comparison, alcohol consumption among young people has been declining over the last decades in Europe [27-29]. However, the prevalence of alcohol consumption, drinking culture and drinking patterns vary across countries in Europe, depending on age, sex, and other factors [30-35]. Changes in alcohol consumption are important to monitor since disease burden is closely related to the average volume of alcohol consumption, and an increase may have public health

consequences [15, 36, 37]. However, little is known about how changing drinking habits in old adulthood affect mortality and health-related quality of life.

1.1 Alcohol

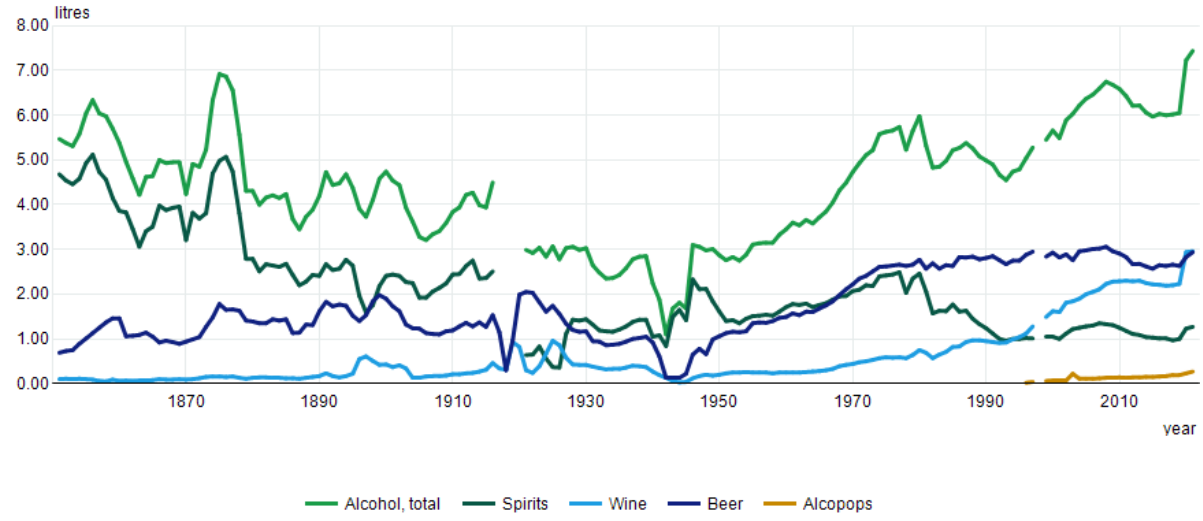
Alcohol was probably the first psychoactive substance used by humans and possibly accidentally discovered through the intake of grains, fruits, juices, honey, milk, tubers and vegetables that were altered by the fermentation process [38]. Fermentation is described as the chemical breakdown of a substance by e.g. bacteria, and through this process sugar or starch can be converted to alcohol. One of the earliest proofs that people were cultivating plants to manufacture alcohol was found in a settlement in Haji Firuz Tepe (Iran), dating to 5400-5000 BC [39]. Random and probably enjoyable encounters with the effect of fermented food and plants turned into a more targeted production of alcohol when Arab scientists discovered the distillation process approximately around 1000 AD [40]. As a result of the discovery of alcohol products, the globalisation of marketing and promotion of alcohol have increased both the amount of worldwide consumption and the harms associated with it.

1.1.1 A historic perspective and traditional drinking culture in Norway

Alcohol consumption in the Nordic countries was described in Roman history books already from 100 AD [41]. Alcohol was also central to Viking culture (approximately 850-1100 AD), both in the Vikings' looting raids and in battles between them [39]. The pursuit of intoxication, that is, the change in everyday consciousness caused by alcohol use - and the pursuit of the good properties of intoxication, has been the most central feature of the use of alcohol in the Nordic culture [42]. In the Gulating Act (Gulatingsloven, 900 AD), which is probably the oldest and best preserved of the landscape laws in Norway, farmers were actually obliged to brew beer for certain holidays [41]. During the Middle Ages, beer was a luxury item for most people in Norway. The grain they had at their disposal they would

probably rather use for porridge, flatbread and seeds than to be used for beer brewing. The first laws that set restrictions on beer drinking and intoxication is found in the Frostating Act (Frostatingsloven) from the middle of the 13th century [41]. It was forbidden to bring beer to the Parliament, and this prohibition was continued in Magnus Lagabøters land law (1274 AD). In Norway, alcohol sales have been registered since 1851. As shown in Figure 1, the statistics provide an overview of the development in sales through the legal channels in Norway. In addition to legally sold alcohol, the total alcohol consumption will include home production, smuggling and purchases abroad or on trips to and from abroad.

Figure 1 *Statistics on alcohol sales, by type of beverage, contents and year between 1851 and 2021.*



Source: *Statistics Norway*. The figures do not comprise Norwegian citizens' purchase of alcohol abroad. Figures for 1998 are not available. Alcoholic beverage: Each beverage with an alcohol content over 0.7 volume per cent. Litres as sold: litres of alcoholic beverage. Used with permission.

After the establishment of the Norwegian constitution in 1814, a liberalization of former spirits production restrictions led to a sharp increase in consumption. Although there is no reliable statistical information from this period, the consumption of spirits in Norway was estimated to be approximately 7 litres pr. inhabitant in 1833 [41]. This represented a very drastic increase from the last part of the Danish era - where consumption was estimated at approximately 1.5 litres in 1814 [41]. Consequently, in the first decades of the 20th century,

the alcohol issue had a prominent place in Norwegian politics and society [43]. Teetotallers' organisations played a major role (DNT Edru Livsstil, founded in December 1859, and IOGT Norway, founded in March 1877) in the public debate towards the end of the 19th century and the beginning of the 20th century, and prohibition of sales of spirits and liqueur was considered as the ultimate way of solving the alcohol problem [43]. The spirituous and liquor ban was introduced in Norway by an Act of Parliament in December 1916. After the prohibition period, which lasted from 1916 to 1927, when the production, importation and sales of spirits and liquor were prohibited, the teetotallers' organisations lost their authority [41]. However, the government in Norway established The Wine Monopoly (Vinmonopolet) in 1922, to increase control of the sale of wine and spirits.

In contrast to the wine-producing countries around the Mediterranean - where the use of wine has primarily been part of the meal / diet, drinking for intoxication has been the dominant custom of the Northern European drinking culture. The other characteristic of the Norwegian drinking culture is that the use of alcohol has been associated with festivities, and special occasions for centuries (e. g. Christmas, Easter, weddings, baptisms, funerals), and that it has otherwise been unusual to consume alcohol [42]. However, after the five-day week was introduced in the 1960s and 70s, it became increasingly common to drink alcohol on weekends as well.

1.1.2 **The study period including the current Norwegian alcohol policy**

In 1985, Ole-Jørgen Skog published his influential theory of population alcohol consumption in a paradigm-changing article [44]. Skog outlined the key arguments for his theory of drinking behaviour as follows:

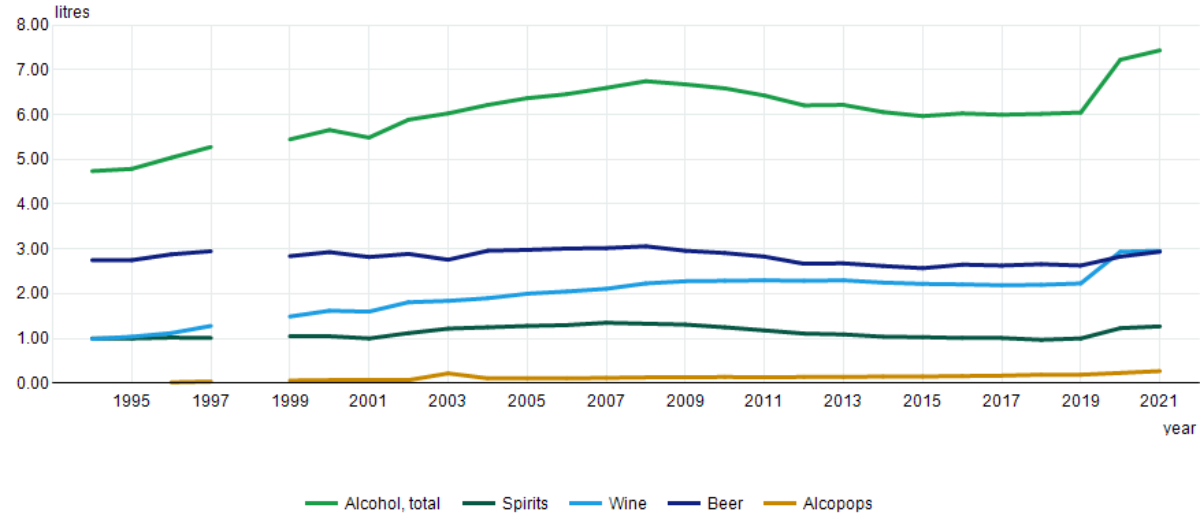
> *"If certain structural requirements are fulfilled, nearly everybody will influence and be influenced by nearly everybody else, either directly or indirectly. In this*

case, the population will tend to behave as a collective. Therefore, the population might be expected to move in concert up and down the consumption scale, thereby creating a close connection between the general level of consumption in the population and the prevalence of heavy use" (1: p. 97)

During the 20th century, Norway has probably had one of the most restrictive alcohol policies in Europe with high prices and restricted availability, and in 2000 the level of alcohol consumption in Norway was one of the lowest in Europe [16, 45, 46]. Strongly influenced by Skog`s theory of the collective components in drinking habits, alcohol sales in Norway have been strictly regulated, have had limited availability through designated stores (like the aforementioned Vinmonopolet), and have been relatively expensive due to high taxes [44]. However, during the recent decades, alcohol liberalization has intensified. Liberalization has not primarily been due to changes in legislation - the legislative changes have come as a result of the changes in the liberal direction in the population [41, 42]. Despite the governmental strategy to have a strict ban on alcohol advertising, with the main purpose of preventing the influence that leads to increased demand for alcoholic beverages, the exemption for editorial coverage of alcohol in newspapers and other media has led to frequent front-page articles about the positive effects of alcohol [47]. There has been an increased tendency to focus on "wine and pleasure" as part of healthy aging in Norway, and a need to arise interest and enthusiasm among older consumers, may have led to a less nuanced coverage of alcohol related research findings [48]. Biased media reports about possible benefits of alcohol on health-related issues, such as heart disease and dementia, may have influenced the perception of beneficial effects of alcohol in old age [30, 49-51]. The supply of cheaper alcoholic beverages through cross-border and international tax-free trade has also increased significantly in recent decades, as has the number of alcohol sales in Norway, and sales of 3-liter wine cartons have become mainstream, not least among older adults [22, 23, 26]. As

shown in Figure 2, there has been a steady increase in alcohol sales from 1994 to 2008, and in 2008 alcohol sales per adult were 10 % above sales 25 years earlier. In addition, there has been a noticeable increase in alcohol sales during the Covid-19 pandemic (2019-2021), when alcohol sales have been around 21 % above what has previously been a normal level [52]. It has been suggested that an important reason for this increase is that alcohol could not be purchased in tax-free shops and abroad due to strict travel restrictions. Increased wine sales accounted for almost the entire increase in alcohol sales between 2019-2021, and older adults in Norway mainly consume wine when they drink alcohol [53]. Furthermore, many Norwegians take their vacations in the Mediterranean countries and a large proportion of older adults have their "second homes" in the south European countries [26].

Figure 2 *Statistics on alcohol sales, by type of beverage, contents and year, 1994-2021.*



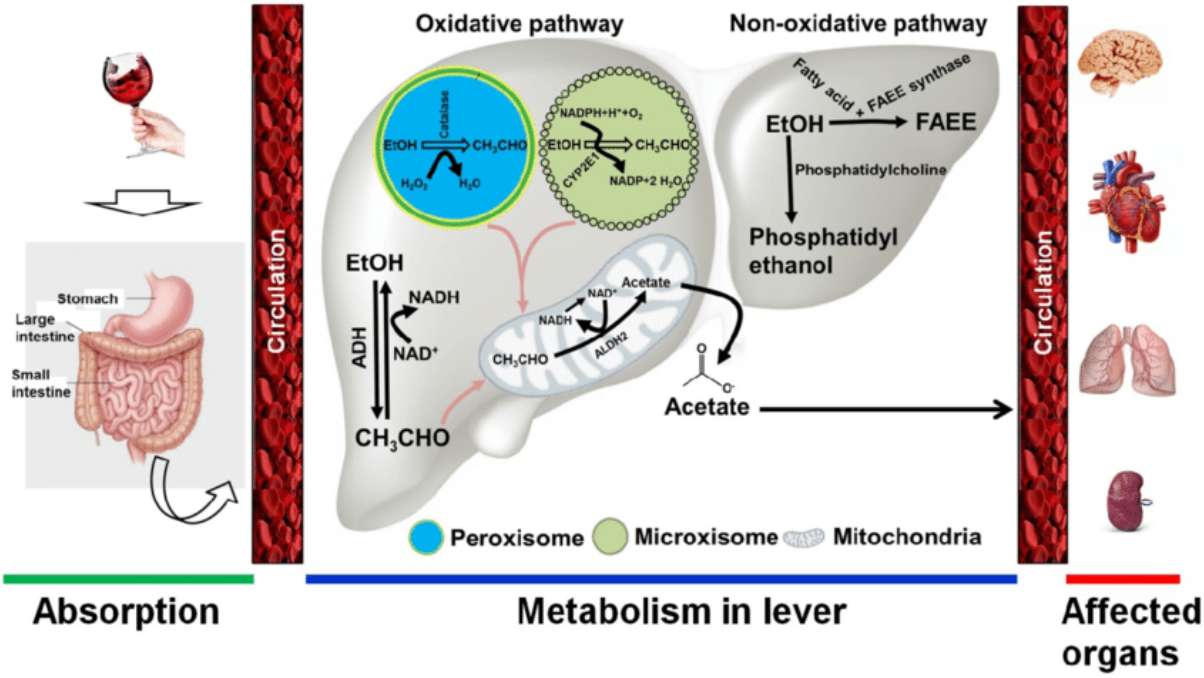
Source: *Statistics Norway*. The figures do not comprise Norwegian citizens' purchase of alcohol abroad. Figures for 1998 are not available. Alcoholic beverage: Each beverage with an alcohol content over 0.7 volume per cent. Litres as sold: litres of alcoholic beverage. Used with permission.

1.1.3 Pharmacokinetics

Pharmacokinetics describes how the body affects alcohol after ingestion. The four primary pharmacokinetic processes are absorption, distribution, metabolism and excretion. Alcohol is both water and lipid soluble, and after it is consumed, it diffuses through biological membranes via small blood vessels in the walls of the stomach and the small intestine [40].

The majority of alcohol absorption occurs in the small intestine, and rapid absorption can be delayed if alcohol is consumed together with food. Blood alcohol concentration (BAC) depends on the amount of alcohol consumed, how fast alcohol was ingested, the body weight of the consumer and the percentage of total body water [54]. Because alcohol is lipid soluble, it easily permeates the blood-brain barrier and enters the brain with an immediate absorption of approximately 90%. The rate of metabolism in the liver also influence BAC. Figure 3 shows the two major pathways involved in ethanol metabolism: 1) the oxidative pathway, and 2) the non-oxidative pathway [55].

Figure 3 *Alcohol metabolism in the body*



EtOH = ethanol; CH3CHO = acetaldehyde; H2O2 = hydrogen peroxide; NAD/NADH = nicotinamide adenine dinucleotide. FAEE = fatty acid ethyl ester. Used with permission [55].

Alcohol metabolism relies on two major nicotinamide adenine dinucleotide (NAD)-dependent enzymes; alcohol dehydrogenase (ADH) and aldehyde dehydrogenase 2 (ALDH2). Alcohol is first converted into acetaldehyde by ADH and cytochrome P450 2E1 (CYP2E1) via oxidative degradation. Acetaldehyde is then oxidized to non-toxic acetate by ALDH and the coenzyme NAD or NADP, which then is broken down into water and carbon dioxide for easy

elimination. In the non-oxidative pathway, ethanol is metabolized to fatty acid ethyl ester, and phospholipase D is involved in producing phosphatidyl ethanol from ethanol. Alcohol and its metabolites are mainly excreted in the urine. However, any remaining unmetabolized alcohol is excreted through the lungs or through perspiration [40]. Many medications can interact pharmacokinetically with alcohol, thereby altering the absorption, distribution, metabolism or excretion of alcohol and / or the medication. Pharmacokinetic alcohol-medication interactions occur most commonly in in the liver [56]. Some of these interactions can occur even at moderate drinking levels and result in adverse health effects. For example, some commonly prescribed diabetes medications (sulfonylurea) and antibiotics (metronidazole, nitrofurantoin) may induce disulfiram-like reactions [56]. These reactions include flushing, which is associated with a dilation of the blood vessels, low blood pressure, and rapid heartbeat, all of which can be dangerous in patients with coronary artery disease.

1.1.4 **Pharmacodynamics**

The effects of alcohol and medications on the body and mind is termed pharmacodynamics. Alcohol can be considered as a psychotropic medication, with stimulating effects at small doses and depressant effects with larger doses [4, 16, 56]. Alcohol works in the brain primarily by increasing the effects of a neurotransmitter called γ-aminobutyric acid (GABA) and dopamine, and decreasing the effects of acetylcholine and N-methyl-D-aspartate (NMDA) [40]. GABA is the major inhibitory neurotransmitter in the brain, and by facilitating its actions, alcohol suppresses the activity of the central nervous system. Benzodiazepines (tranquilizers, anxiolytics) and hypnotics (sleep-inducing drugs) also stimulate the GABA receptors and may therefore potentiate the effects of alcohol. Stimulating effects of alcohol occur at low BAC and may include euphoria, increased self-confidence, increased social behaviour, but also increased aggression and violence. With increasing BAC, sedation, impairment of cognitive, memory, motor, and sensory functions, and a generalized depression

of the central nervous system function are produced by alcohol. Pharmacodynamical alcohol-medication interactions occur most commonly in the central nervous system (CNS), where alcohol enhances the effects of the medication (e.g., sedation / intoxication, orthostatic hypotension, and impaired psychomotor function) [57]. Several classes of prescription medications can interact pharmacodynamically with alcohol, including antidepressants, antipsychotics, benzodiazepines, hypnotics, antihistamines, and opioids [56, 58].

1.1.5 Changes in pharmacokinetics and pharmacodynamics of alcohol due to aging

Alcohol does not dissolve in fat tissues but is distributed throughout the body water, i.e., the blood and the watery fluid surrounding and inside the cells [56]. The proportion of body water and body fat differs between men and women and between young and old people. As aging occurs, lean body mass and total body water decrease, and thus the same level of alcohol intake results in higher levels of BAC in older adults than in their younger counterparts [20, 59, 60]. Older women may be even more vulnerable to the acute physical, psychological and cognitive adverse effects of alcohol than older men, due to naturally lower levels of body water in women than in men, resulting in higher BAC after drinking equivalent amounts of alcohol [61]. Of importance for the metabolism of alcohol, the liver undergoes various changes with increasing age, including reduced hepatic blood flow (40–60%) and decreased liver mass (20–40%) [62]. However, it has been subject for some debate, whether increasing age in healthy older adults affects the alcohol degradation rate. In a response to a BMJ editorial that expressed concern about increased alcohol consumption among older adults [63], Skovenborg claimed that reduced metabolic efficiency in older adults is merely a myth, since alcohol pharmacokinetics have only been sparsely studied in humans [64]. Of the few pioneering studies on alcohol metabolism, Vestal et al found that the rate of ethanol degradation was not affected by age [65]. Nevertheless, as a result of reduced size of the kidneys, and decreased renal blood flow and glomerular filtration as aging occurs, the

excretion of alcohol and its metabolites in the urine can be slower [40, 58, 66]. Moreover, aging is accompanied by a decreased number of synapses in the brain and downward receptor signalling. The literature suggests that increased neuronal receptor sensitivity may result in increased susceptibility to the adverse effects of alcohol, benzodiazepines, and hypnotics in older adults [60, 67, 68].

1.2 Older adults

The current heterogeneity in health status among aging adults is probably more substantial than in the past [69]. Many older people have healthy life years up to the age of 90. An increasing proportion also pass 100 years, before the need for health, welfare and care services arises [70]. Still others get age-related illnesses already in their 50s or 60s. Despite healthy aging, older people may be particularly vulnerable to the physical, psychological and cognitive effects of alcohol, so that harmful effects may manifest at lower levels of consumption [20, 57, 59]. The general aging process is characterized by weakened adaptive and homeostatic mechanisms, which result in a reduced ability to deal with external stressors such as alcohol [59, 66, 71]. There is no uniform definition of aging from a biological or clinical point of view or from which age *old adulthood* begins. The World Health Organizations definition is that *elderly adults* are between 61 and 75 years old, *old* persons are between 76 and 90 years, and those beyond 90 years are the *oldest old* [72]. In this thesis, I will define older adults as those aged 60 years and older.

1.2.1 The pre-world war II generation and the baby boomers

Historically, alcohol consumption has been very modest in older compared to younger adults [4, 18, 20, 71, 73]. It was long thought that, with only a few isolated exceptions, alcohol abuse simply did not exist among older adults [20, 74-76]. Excessive drinking was described as self-limiting in old adulthood, that ended in either abstinence or death before old age was reached

[74]. Thus, the pre-world war II generation is often referred to as the “dry generation”. In an editorial in the Journal of the Norwegian Medical Association (Tidsskriftet for den norske Legeforening), in connection with the findings of increased alcohol consumption in Norway between 1993 and 2000 [77], the results were downplayed;

> *Thanks to the frugality of our ancestors and respect for alcohol, I think we will still sit safely and dry on land - at least a few more generations (takket være våre forfedres nøysomhet og respekt for alkoholen tror jeg vi fremdeles vil sitte trygt og tørt på land – i alle fall noen generasjoner til) [78].*

Recent findings of increased alcohol consumption among older but not younger adults, have in fact been referred to as a “silent epidemic” by the Royal College of Psychiatrists [20]. The changing alcohol habits of older adults have been suggested to represent a cohort effect from the “baby boomers” (those born between 1946 and 1964) [25, 60, 74, 79]. The baby boomers had higher exposure to alcohol in their youth and tended to be more lenient about substance use than earlier generations [40, 80]. Indeed, more liberal attitudes towards alcohol among the current cohort of older people in Europe have been reported [4, 49, 81]. In 2006, the first baby boomers turned 60 years, and by 2025 the entire baby boom generation will be 60 years or older.

Important characteristics of current and future cohorts of older adults in Norway and many other European countries are a high educational level, a high income, gender equality, and a focus on individualism, self-realisation and pleasure [49, 81, 82]. Far more among the current cohort of older adults have higher education compared to previous generations, and this is especially true for women. Among tomorrow's older people, even more women will have a high level of education [83]. This will influence the values, preferences and competencies among future older adults. Previous international studies have found that sense of control

(mastery) decreases from age 60, and more so for women than for men. Sense of control is an important aspect of "aging well" [81]. Findings from the NorLAG study (Norwegian Life Course, Aging and Generation Study) indicate that the decline in sense of control starts ten years later in Norway compared with other European countries, and that the increasing gender gap was explained by previous educational differences [81, 83]. Higher educational level is associated with both increased sense of control and increased alcohol consumption. However, we do not know how the interplay between higher educational level, increased sense of control and increased alcohol consumption will affect the health of future generations of older adults. Given the information about changes in values and attitudes to gender equality, drinking behaviour may continue to become more equal between the sexes [33, 84-86]. How this will affect morbidity, health expenditures and mortality in older adults is still unknown.

Urbanization is also a strong trend in all western countries and is indirectly linked to higher educational levels, including among older adults. The NorLAG study found that far more urban living women had "high" alcohol consumption compared with those living in rural areas, while there were only insignificant differences among men [81]. This aspect will probably add to the aforementioned development of more equal drinking habits between older men and women. There is also a higher degree of equality among the baby boomers in Norway, compared with other countries in Europe, since women have increased their work participation considerably and thus improved their socioeconomic status compared to men in recent decades [87, 88]. Social mechanisms such as stress caused by women's dual roles, imitation of male drinking patterns, changes in male-female drinking companionship and changes in alcohol's position as a symbol of gender roles are suggested to have influenced baby boom women's drinking behaviour in particular [84].

1.2.2 **Polypharmacy, comorbidity and interactions with alcohol**

For older adults, consuming alcohol probably involves a higher risk of adverse health consequences compared with their younger counterparts, due to several age-associated physiological and pathophysiological changes that can affect alcohol disposition [56-58, 89]. Furthermore, poorer health and increasing use of over-the-counter or prescribed medications may negatively interact with the use of alcohol. In spite of this, several studies have found that the number of older people who combine alcohol and psychotropic drugs increases [89-91]. Further, it has been found that older adults in Norway account for about half of the total consumption of psychotropic drugs (antipsychotics, anxiolytics, hypnotics and antidepressants) [92]. Unfortunately, there is a lack of inclusion of older adults with multimorbidity and those over 80 years in studies, the knowledge gap on the health consequences of polypharmacy, comorbidity and advancing age related to alcohol use is therefore large [66]. Nevertheless, from examining the interactions between alcohol and many commonly prescribed medications among older adults, several clinically relevant potential adverse effects may be observed, as listed in Table 1 [56, 58, 93]. The list is not exhaustive and additional resources should be consulted when evaluating the safety of concurrent use of alcohol and medications, such as https://www.drugs.com/article/medications-and-alcohol.html.

Table 1 *Interactions between alcohol and various medications or classes of medications*

Medication or medication class	Mechanism	Clinical effects
Opioids	Additive sedative effects	Over sedation, increased risk of fatal overdose due to respiratory depression
Nonsteroidal anti-inflammatory drugs (NSAIDs)	Additive damage to the gastric mucosal barrier	Increased risk of gastrointestinal bleeding
Antibiotics (metronidazole, nitrofurantoin, sulfamethoxazole	Inhibition of hepatic ALDH2 reducing elimination of aldehyde	Disulfiram-like reactions (i.e., flushing, nausea, vomiting, sweating)
Cardiovascular medications (nitrates)	Inhibition of hepatic ALDH2 reducing elimination of aldehyde	Disulfiram-like reactions (i.e., flushing, nausea, vomiting, sweating)

Diabetes medications (sulfonylureas)	Inhibition of hepatic ALDH2 reducing elimination of aldehyde	Disulfiram-like reactions (i.e., flushing, nausea, vomiting, sweating)
Analgesics (aspirin)	Aspirin increases gastric emptying	Faster alcohol absorption in the small intestine (↑BAC)
First-generation (sedating) antihistamines	Additive CNS effects	Excessive sedation, decreased motor skills, dizziness
Alpha-1-adrenergic blockers (also used to treat enlarged prostate), beta-blockers, calcium channel blockers, vasodilators	Additive hypotensive effects soon after alcohol ingestion	Increased risk of postural hypotension
Benzodiazepines	Alcohol inhibits the metabolism, additive CNS depression	Excessive sedation, drowsiness, and impaired psychomotor function
Nonbenzodiazepine hypnotics, z-hypnotics	Alcohol inhibits the metabolism, additive CNS effects	Excessive sedation, impaired psychomotor function, disorientation, incoherence, and confusion
Tricyclic antidepressants	Additive sedative and hypotensive effects	Over sedation, increased risk of orthostatic hypotension
Bupropion	Increased effects of alcohol; acute alcohol consumption and alcohol discontinuation along with bupropion can reduce the seizure threshold	Alcohol intoxication, increased risk of seizures
Atypical antipsychotics	Additive CNS effects and antihypertensive effects	Excessive sedation and postural hypotension
Statins	Additive hepatotoxicity from both chronic excessive alcohol use and statins	Increased risk of liver damage
Methotrexate	Additive hepatotoxicity	Increased risk of liver injury
Metformin	Concurrent use may lead to increased blood levels of lactic acid	May cause lactic acidosis (with symptoms of muscle pain, bradycardia, and dizziness)

Some commonly used medications that interact with alcohol [56, 58, 93]. ALDH2 = aldehyde dehydrogenase 2; CNS = central nervous system; BAC = blood alcohol concentration

1.2.3 Standard drinks, alcohol units and drinking recommendations in older adults

Different types of alcoholic beverages contain different amounts of pure alcohol and glass sizes vary between places where alcohol is served. Using standard drinks or defining alcohol units to measure the individual alcohol consumption is more accurate than counting the number of "alcoholic beverages" consumed. However, the definitions of one "standard drink"

or “one unit” of alcohol vary considerably around the world (i.e., how much pure alcohol a drink contains) [94, 95]. For example, one unit in the UK and Iceland is 8 g of alcohol, in Australia it is 10 g, in Italy it is 12 g, the US standard drink is equivalent to 14 g, whereas in Austria and Japan it is 20 g of alcohol [16]. In this thesis, I will use the term *alcohol unit*. One unit is defined as 12 g of alcohol in Norway [26]. The Norwegian equivalencies for one alcohol unit is

- A bottle (33 cl) of beer at 4.5 vol%
- A small glass of wine (12.5 cl) at 12 vol%
- An even smaller glass of liquor (7.5 cl) at 20 vol%
- A very small glass of spirits (4 cl) at 40 vol%

Drinking recommendations may help people to drink safely by suggesting levels of consumption that have been shown to be low-risk for injury or harm. Consumption thresholds are often based on exceeding either a day threshold or a week threshold. No international consensus in drinking guidelines exists. Nevertheless, several countries have their own recommendations for “safer” drinking, and some according to old age and sex [96-99]. Contrary to several other countries, Norwegian authorities do not give general recommendations on drinking thresholds, except that pregnant women are advised to abstain from alcohol [96, 97, 100] and that those under 18 years are not allowed to drink beer and wine and those under 21 are not allowed to drink spirits. There is an ongoing debate among researchers about what constitutes consumption-based risk, and also whether it is reasonable to use a lower consumption threshold for older adults [101-104]. In the report “Our invisible addicts” from the Royal College of Psychiatrists, they recommend an upper limit of 1.5 units a day for persons aged 65 years and over and binge drinking is defined as the consumption in a single session of > 4.5 units for men and > 3 units for women [20]. In the US, it is

recommended that healthy adults over the age of 65 years should not drink more than 3 standard drinks on any one day and no more than 7 drinks a week, while in Australia, low-risk drinking for healthy older adults is defined as no more than 2 standard drinks in a day [101]. Recently, Canadian guidelines were published recommending that women aged 65 years or older should not exceed one standard drink per day, and drink no more than 5 drinks per week; for men 65 years or older, they recommend not to exceed 1-2 standard drinks per day, with no more than 7 drinks per week in total [98]. The National Institute on Alcohol and Alcoholism (NIAAA) previously advised older adults 65 years and over to consume no more than 7 standard drinks per week and / or 1 drink on any one day [105]. The NIAAA has recently revised their recommendations and now advises that *all* adults limit alcohol intake to 2 drinks or less in a day for men and 1 drink or less in a day for women, and those who take certain over-the-counter or prescription medications or have certain medical conditions should avoid alcohol completely [106]. Efforts have been made to formulate a common definition of low-risk drinking limits, but an implementation is so far out of reach due to the absence of scientific data, which allows each country to define its own "guesstimate" [94, 101].

Moreover, differentiating between average drinking volume and frequency of heavy episodic drinking (HED), also called binge drinking, is considered important to gain greater insight into the health effects of alcohol consumption [107-110]. Especially since binge drinking may be particularly harmful in older adults [37, 96, 108]. However, the number of alcohol units defined as HED varies between studies, including depending on age and sex, ranging from 3+ to 6+ units in a single session [94, 97].

In this thesis, I will use the term "frequent drinking" defined as drinking 2-3 times per week or more often (sub-study I); "at-risk drinking" defined as AUDIT-C ≥ 3 in women and ≥ 4 men (sub-study II), *or* ≥ 3 units / ≥ 36 g of ethanol (sub-study I) on typical drinking days, and "high-level drinking" defined as drinking on average ≥ 100 g of ethanol per week (sub-study

III). I will use the definition of HED based on the Alcohol Use Disorders Identification Test [111], and the Norwegian size of one alcohol unit, thus HED is 6+ units in a single session / ≥ 72 g of ethanol (sub-study I & II).

1.2.4 Prevalence and trends in alcohol consumption and at-risk drinking among older adults

The average worldwide consumption is estimated to be 6.2 litres alcohol per capita (APC) per year, but there is a wide variation between different countries [16, 36]. APC consumption in the WHO European Region was 11.2 litres in 2010 and decreased to 9.8 litres in 2016 [16]. Comparatively, total APC consumption decreased from 9.0 litres in 2010 to 7.5 litres in 2016 in Norway, whereas APC among drinkers (excluding abstainers) was 9.4 litres in 2016. The overall abstinence rate in Norway was 12% among males and 30% among females in 2016 (aged 15+). According to the figures, alcohol use is declining among adolescents and young adults in Norway [26].

Recent studies report that older adults in the US [85, 112-114], and in several of the European countries [30-32, 34, 86], including in the Nordic countries [26, 33, 90, 115], have increased their alcohol consumption over the last decades, with diminishing sex differences in drinking patterns. However, the magnitude of the changes in alcohol consumption and the size of the changes in differences between the sexes (i.e., prevalence rates for men compared to women) vary considerably, depending on factors such as age, social class, education, ethnicity, and geographical settings [16, 35, 46]. Nevertheless, the abstinence rate among older adults aged 60 years and older has been shown to be higher in the US and several of the European countries than in the Nordic countries. Approximately 40-55 % of older men and 55-75 % of older women are abstaining from alcohol in the US [24, 112], while the proportion of abstainers range from 10 % to 94 % among older adults in European countries, with an

average of 40 % [16, 32]. In comparison, an abstinence rate has recently been reported among older adults in Norway between 10-18 % in men and 13-29 % in women (depending on age group), and 10 % in older men and 15-22 % in older women in Denmark [115].

In addition, the prevalence of potentially harmful drinking among older adults varies from 9 % to 53 %, or even more, since the criteria for "at-risk", "hazardous" or "potentially harmful" drinking among older adults are currently inconsistent and vary between studies [24, 51, 80, 94, 101, 105, 114, 116, 117].

All things considered, the discrepancy in sizes of standard drinks, alcohol units, number of drinks defined as HED and different low-risk drinking thresholds affects prevalence estimates for at-risk drinking across studies, and results in conflicting findings [118]. In this thesis, I will use "at-risk", "risky", "hazardous", "unhealthy" and "potentially harmful" synonymously, due lack of evidence to provide a more reliable definition.

1.3 Factors associated with elevated alcohol consumption and health-related consequences in older adults

Excessive drinking in later life, as opposed to moderate drinking, has been associated with factors such as lower socioeconomic status, male gender, being closer to middle age, significant polypharmacy, comorbidity, cognitive impairment, poor mental health, loneliness, and living alone [68, 114]. However, most findings are based on older studies conducted in the US, and because drinking behaviour and problems are strongly influenced by cultural, ethnic, socioeconomic and geographical factors, knowledge about risk factors for potentially harmful alcohol consumption in the current generation of older adults in European countries is deficient [119]. Unhealthy drinking among older adults is suggested to be under-detected, partly as a result of scarce evidence of what constitutes risky drinking in old age, as well as a

lack of understanding of which older adults are at risk of harmful drinking [71, 94, 100, 120]. Increased knowledge of factors associated with potentially risky drinking in the current generation of older adults can aid physicians to better target patients in need of intervention [121].

1.3.1 Demographics and psychosocial factors

Gender

Older men have traditionally drunk more frequently and consumed larger quantities on typical drinking days than older women [4, 22, 30, 32, 87, 122, 123]. Although a consistent finding across studies is that male gender is predictive of an unhealthy drinking pattern, recent findings suggest increasing trends in past-month binge alcohol use and alcohol problems among older women in many developed countries [17, 33, 85, 112, 113, 124-126]. However, the cultural and geographical context strongly influences sex differences in alcohol consumption, with societies that foster more equal gender roles showing increasingly similar levels of binge drinking and at-risk drinking between men and women [34, 81, 127, 128]. Moreover, biological factors, including greater sensitivity to the acute effects of heavy drinking among women as described in section 1.1.5, may explain some of the sex differences associated with some alcohol measures [4, 17, 59, 61].

Educational level and income

There is a positive correlation between higher educational levels and higher levels of alcohol use, and this association is shown to be stronger for women than for men [51, 105, 129-131]. Correspondingly, a clear correlation between higher income and increased alcohol consumption has been found [24, 131-133]. However, some evidence indicates cultural and gender differences in this relationship. For example, in the US, at-risk drinking was associated with lower educational levels among older men, but higher educational levels among older

women [128]. Correspondingly, there were opposite findings for the relationship between upper level of education and hazardous drinking between Norway and China, indicating increased risk of evolving unhealthy drinking patterns among socially privileged older adults in developed compared to underdeveloped countries [130]. On the other hand, a higher educational level has been shown to strongly correlate with better health outcomes (both SRH and mortality) for all levels of alcohol consumption, often referred to as the "alcohol-harm paradox" [134-137]. In comparison, both abstinence from alcohol and alcohol use disorders are associated with lower socioeconomic status [4, 105, 137].

Culture and cohort effects

Total alcohol consumption is higher in developed countries than in developing countries and is higher in Europe compared to the US, but it also varies widely across European countries [16, 36, 46]. Furthermore, it has been shown that younger birth cohorts of older adults in the US are more likely than older cohorts to engage in HED and to develop alcohol disorders, whereas this cohort effect was not found in western Europe [125]. Correspondingly, rates of alcohol-related hospital admissions among baby boomers have increased compared with the pre-world war II cohorts, which may be a function of cohort effects [7]. However, the populations in the US studies may differ from the populations in the European studies, since the "collectivity" of drinking cultures is both geographically and temporally defined [44, 50, 138]. Nevertheless, alcohol use problems are currently more frequent in developed regions such as North America and the European countries than in developing countries [71].

Urban versus rural living

Several studies have found that elevated drinking is associated with urban compared to rural residency [129, 130, 139]. As described in section 1.2.1, a growing number of older people in western European countries live in and near cities, and this may increase public health concerns due to alcohol problems among future generations of older adults.

Spouse / partner or living alone

A large body of evidence has shown that men who live alone, have a greater risk of unhealthy drinking, while the opposite is true for women [30, 51, 140, 141]. In line with this, several studies have found that separated, divorced or widowed men have a greater risk of harmful drinking, whereas this association was not found among women [24, 131, 142]. It has been suggested that loss of spousal care and control may be an explanation for this drinking behaviour in men [142]. On the contrary, cohabiting older women in England and married older women in Germany were more likely to exceed drinking guidelines compared with single, divorced or widowed women [123]. Thus, it seems that alcohol consumption goes in the opposite direction between cohabiting and single older women and men, which indicates different needs, reasons and motivations in relation to drinking (e.g., women's role as moderators of other people's drinking) [84].

Loneliness, friends and social engagement

Loneliness is prevalent among older adults and it has been considered a risk factor for excessive alcohol use [68, 143]. Some studies have found that at-risk drinkers indeed use alcohol to relieve loneliness [131, 144]. Alcohol problems are more significant among socially disadvantaged older males, while women without social support show more improper use of prescription drugs [80, 105]. However, a growing body of evidence shows that baby boomers use alcohol in pleasant social gatherings and that increased social engagement is associated with increased drinking [105, 145-147]. Among current older adults, alcohol is perceived as a marker of transitions, a "social lubricant" in connection with celebrations, in meetings with friends and relatives, and a facilitator for relaxation and joy [49, 148]. In addition, it has been shown that social interaction does not reduce binge drinking or alcohol problems among older adults [149, 150]. In contrast, decreased social activity is associated with reduced alcohol consumption among baby boomers [132, 151].

Sleeping pills and sleep problems

Alcohol is widely used by older adults for sleep disturbances, especially among men [152-154]. Although alcohol can help initiate sleep, the consumption of alcohol also adversely affects the quality and length of sleep [155]. Inadequate sleep is strongly associated with poorer self-reported health [156]. Approximately half of older adults aged 60 years and older complain about difficulty initiating or maintaining sleep, whereas the overall prevalence of insomnia symptoms ranges from 30% to 48% in older adults [157]. The proportion of older adults who combine alcohol and medication, such as sleeping pills and / or benzodiazepines has increased, and the literature suggests that men combine sedative hypnotics with alcohol more often than women [80, 90, 91]. Benzodiazepine-like drugs (z-hypnotics) are the most commonly used drugs for treatment of insomnia in Norway and are only recommended for short-term treatment not exceeding 4 weeks [158]. More than 25% of Norwegians aged 70-89 years, filled at least two prescriptions for one of the medication subgroups; anxiolytic benzodiazepines, hypnotics benzodiazepines, or z-hypnotics in 2008 [159]. Benzodiazepines and z-drugs (zopiclone and zolpidem) are often prescribed to older adults, and to women in particular, indicating that many older adults in Norway are regular users of sedative hypnotics [158-162].

Mental health and psychological distress

Psychological distress, poor mental health and low satisfaction with life is correlated with binge drinking and at-risk drinking among older adults [114, 129, 149, 163]. Coupled with this, at-risk drinkers report that they drink alcohol to reduce depression, anxiety and their feeling of lack of meaning of their lives [144]. Moreover, excessive alcohol use has been found to be predictive of depression, global psychological distress, and decreased quality of life [139, 143]. Some evidence indicates sex specific differences associated with depression and at-risk drinking. Depression is associated with heavy drinking in men but not in women,

and it has been suggested that binge-drinking older men may use alcohol to cope with depressive mood, and that heavy drinking may contribute to their social isolation and depressive symptoms [51, 164]. In contrast, daily drinking among older adults in Germany was positively associated with a *reduction* in psychological distress and also a higher life satisfaction [132]. In comparison, a large prospective study from England found that being depressed was not associated with harmful drinking in older adults compared to other drinking levels [131]. Some evidence has indicated that moderate drinking, as opposed to drinking above recommended limits, has a protective effect against depression [165, 166]. However, a study among older adults in Spain and UK found no protective effect derived from moderate alcohol consumption on the risk of developing depression compared to other levels of consumption [167]. Furthermore, they found that drinkers with a preference for wine presented an increase in psychological distress. These differing findings may suggest that cultural and social factors play a role in the interplay between drinking and mental illness.

Medical illnesses

Excessive drinking, as compared with moderate drinking, has been found to be related with having chronic diseases [68, 105]. On the other hand, it is well-known that former drinkers often stop consuming alcohol when their health status worsens, which is known as "the sick quitters effect" [110, 168]. The NorLAG study also found that getting a chronic health condition contributed to lower alcohol consumption among Norwegian older adults [83].

Cardiovascular disease and CVD risk factors

The major cause of death in Norway is cardiovascular disease. From 2005 to 2015, deaths related to cardiovascular disease were reduced by 20% [169]. There are mixed findings on the relationship between cardiovascular disease and alcohol consumption, but most findings suggest a J- or U-shaped association, with a lower risk for moderate drinkers compared to abstainers or heavy drinkers [103, 170-173]. However, favourable lifestyle factors often

coincide with moderate alcohol intake, which may imply reverse causation. Genetic epidemiological studies have suggested that alcohol consumption in all amounts is associated with increased cardiovascular risk, but that there are marked risk differences across intake levels [174]. In addition, epigenetic factors and environmental familial factors may influence the health effects of different levels of alcohol consumption [175]. On the other hand, frequent heavy drinking occasions (HED) also show mixed results as a risk factor for cardiovascular disease [37, 108, 176, 177]. Many researchers argue that average alcohol consumption is not sufficient to examine the risk relation between alcohol consumption and cardiovascular disease since drinking patterns may moderate the effect of alcohol [109].

Smoking

Compared with moderate drinking, at-risk drinking has been found to be significantly associated with smoking [51, 105, 178]. Smoking is the lifestyle factor that claims most lives in Norway, and it is strongly associated with cardiovascular disease. Every fifth death before the age of 70 years is attributable to smoking. Smoking has decreased considerably in Norway over the last decade, but more than 10% of the adult population still smoked on a daily basis in 2016 [169].

BMI

Obesity (>30 kg / m2) is associated with a considerably increased risk of illness and impaired health. According to the *2017 Lancet Commission on dementia prevention, intervention, and care life-course model,* obesity is one of the modifiable risk factors, along with, for example, excessive alcohol consumption, less education, hypertension, smoking, depression, physical inactivity, diabetes, and infrequent social contact [179]. In Norway, obesity among adults is increasing and in 2016, approximately 25% of men and 21% of women aged 40–69 were obese. On the other hand, among older adults, malnutrition and underweight may be a greater risk factor for poorer health (SRH) and mortality than obesity [180].

Hypertension

In addition to smoking and unhealthy diets, high blood pressure is the modifiable risk factor that results in the most deaths in the Norwegian population, as it contributes to cardiovascular disease [169]. The proportion of the population with hypertension has decreased among older adults between 2005 and 2016 and the proportion with high blood pressure was 25-36% in 2016. Excessive alcohol consumption is associated with high blood pressure [61, 174, 181].

Physical activity

Benefits have been found from positive health behaviours, particularly performing regular physical activity over time, for reducing the risk of poorer health in relation to alcohol consumption across old adulthood [182]. In Norway, as in many European countries, the proportion of physically active people is highest among those with higher educational levels [169].

1.3.2 Self-rated health

Self-rated health (SRH) is a subjective measure of the current state of health and has been widely used in population surveys. SRH is a well-known predictor of future health outcomes, use of health services, and mortality in adults over 60 years, even in populations without a known disease burden [183-185], including the population in this thesis [186]. The novelty of using SRH as an outcome indicator for the health consequences of alcohol consumption is its ease of use because it only consists of a single question, and its ability to predict the use of health services and health expenditures [187, 188]. Evidence suggests that SRH captures a wide range of health dimensions, including physical, psychological, and functional health [183, 186]. Nevertheless, physical illnesses, mental health, sex and social context are related to SRH, especially in older adults [189]. Understanding the mechanisms for maintaining good

SRH in aging in both sexes, as well as risk factors for poorer SRH, can identify opportunities for health promotion and interventions [184, 185].

1.3.3 **Mortality**

Excessive alcohol consumption is a leading risk factor for injuries, chronic disease and mortality [14-16, 36, 37]. The proportion of alcohol-attributable deaths varies widely between regions in the world, and the European region has the highest proportion, with more than one in every ten deaths in European men [36]. Compared with older adults who abstain from alcohol, the risk of all-cause mortality has been shown to decrease in men reporting up to four standard drinks per day and in women who consume one or two drinks per day [103, 173, 190]. In line with this, it has been found that abstaining from alcohol is associated with a greater risk of death and poorer health-related quality of life, while moderate alcohol intake can have health benefits for older adults, and this is especially true in women [191, 192].

Although it has been widely accepted that a J- or U-shaped association exists between alcohol consumption and adverse health outcomes and mortality, with a lower risk for moderate drinkers compared to abstainers or heavy drinkers [108, 173, 193-195], recent evidence casts doubt on whether any beneficial health effect of alcohol exists [16, 103, 192, 196]. Systematic errors may be operating in prospective epidemiological mortality studies that have reported moderate use of alcohol to be “healthier” than abstinence, when using current abstainers as the reference group. An extensive amount of evidence has shown that people decrease or stop their alcohol consumption as they age and become ill or frail [108, 168, 197, 198]. Meta-analyses adjusting for these factors have found that moderate alcohol consumption has no net mortality benefit compared with lifetime abstention or only infrequent drinking [199].

Findings are also inconsistent on whether women and men have differing mortality risks from the same levels of alcohol use, some indicating that older women tolerate alcohol as well as older men [185, 190, 192].

2 Aims of the thesis

There is growing evidence of increasing alcohol consumption among older adults, but previous studies have had inconsistent findings on the magnitude of increase, associated characteristics of at-risk drinkers, including sex and gender differences, and health-related consequences associated with high-level alcohol consumption in old age. Thus, the overall aim of this thesis was to investigate trends in alcohol consumption and associated factors among older adults from the same geographical setting across 25 years, and the health-related consequences due to alcohol use.

More specific aims were to:

1. Longitudinally investigate whether alcohol habits among older adults ≥ 60 years had changed in the period 1994 – 2016, controlled for well-known confounders. We aimed to describe age- and sex-stratified changes in i) the proportion of current drinkers ii) the alcohol drinking pattern in terms of past year drinking frequency, and quantity on typical drinking days (≤2 units / ≤24 g of ethanol, here defined as "moderate" or ≥ 3 units / ≥36 g of ethanol, here defined as "at-risk"), and iii) heavy episodic drinking (HED) last year (6+ units in one session). In particular, we aimed to investigate whether sex-related differences in alcohol consumption among older adults have changed.
2. Cross-sectionally investigate the prevalence of three outcomes of at-risk drinking among the current cohort of older adults ≥ 60 years (i.e. AUDIT-C threshold of ≥ 3 for women and ≥ 4 for men, drinking any 6+ in the past year, and reporting any alcohol problems). Furthermore, to investigate factors associated with at-risk drinking, and examine sex-related differences in alcohol consumption in the context of sociodemographic and selected health characteristics.

3. Longitudinally investigate the relationship among alcohol consumption, self-rated health (SRH) and all-cause mortality risk in a general population of adults ≥ 60 years, and to quantify the extent to which any independent effects of exceeding suggested low-risk drinking thresholds combined with the relevant risk factors leads to later consequences; i.e., whether subgroups have any increased health risks due to high alcohol consumption.

3 Material and methods

3.1 The Tromsø Study

The Tromsø Study is an ongoing population-based cohort study conducted in the municipality of Tromsø, situated at 69° N. Tromsø is the seventh largest city in Norway. The Tromsø Study is Norway's most comprehensive and most participated population study [200]. In 1994, the number of inhabitants in Tromsø was 54,600, and in 2016 it had increased to 73,480. Tromsø is a centre of education, research, health-services, administration, tourism, and fishing related activities. The population is dominated by Caucasians of mainly Norwegian origin, but also includes a Sami minority. Tromsø may be considered as representative of a Northern European, white, urban population [201]. The Tromsø Study was initiated in 1974 to investigate the causes of the high mortality from cardiovascular disease in northern Norway, compared to other parts of Norway [202, 203]. It currently consists of seven surveys (referred to as Tromsø1-7). A total of 45,473 persons have participated in at least one of the seven surveys. All participants have received a self-administered questionnaire, including questions about alcohol habits, a wide range of illnesses, symptoms, health behaviours, social conditions and education. In addition, specially trained personnel performed biological sampling (i.e., total cholesterol), and clinical examinations (i.e., weight, height, blood pressure). According to an FHI (The National Institute of Public Health) report from 2016, which published *recorded* sales of alcohol per inhabitant from grocery stores and Vinmonopolet, Tromsø residents bought more alcohol (5.9 litres of pure alcohol) than the average in Norway (5.0 litres of pure alcohol) [204]. In addition, the neighbouring municipality of Tromsø (Balsfjord), where many Tromsø residents have their cabins, had the 4th highest alcohol sales in Norway (6.4 litres of pure alcohol). This thesis included data from one or more of the four latest waves of the Tromsø Study (Tromsø4-7) conducted between 1994 and 2016.

3.2 The Norwegian Cause of Death Registry

Time of death was retrieved from the Norwegian Cause of Death Registry (CoDR) [205]. The coverage of the CoDR is almost complete [206]. For all deaths in Norway, a doctor must complete a declaration of death (death certificate), that conforms to principles established by the WHO. The CoDR has used the ICD (International Classification of Diseases and Related Health Problems) coding system since 1951. The purpose of the CoDR is to monitor causes of death and elucidate changes in these causes over time, and provide a basis for preparation of statistics, research, planning and quality assurance [206, 207]. The data from CoDR can be linked to other health registries and sources of data, e.g., data from the Tromsø Study, after permission has been granted from Regional Committee for Medical and Health Research Ethics (REK).

3.3 Measurements and questionnaires

3.3.1 Alcohol consumption

Alcohol consumption was measured with an adaptation of the AUDIT-C (Alcohol Use Disorders Identification Test-Consumption), which is an abbreviated version of the 10-item AUDIT, developed by the WHO for early detection of persons with harmful alcohol consumption [208]. The AUDIT-C consists of three items on the past years` frequency of drinking (never, monthly or less, 2–4 times a month, 2–3 times a week, or 4 or more times a week), number of drinks on a typical drinking day (1–2, 3–4, 5–6, 7–9, or 10 or more), and frequency of heavy episodic drinking (HED), 6+ units in one session (never, less than monthly, monthly, weekly, daily or almost daily) [111]. The AUDIT-C is recommended for identifying at-risk drinking in older adults [116, 209, 210].

3.3.2 **Sociodemographic variables**

Age was measured as a continuous variable and additionally recoded into different age groups in the three sub-studies. Educational level was categorised as “primary / elementary school (up to 10 years)”(1), “secondary/upper secondary education (up to an additional three years)”(2), and “college / university / tertiary education (at least four additional years)”(3). Relationship status was assessed by the question “Do you live with a spouse / partner?”, with the response alternatives of “Yes” or “No”. Social support questions were “Do you have enough friends who can give you help and support when you need it?”, and “Do you have enough friends you can talk confidentially with?” with the response alternatives of “Yes” or “No”.

3.3.3 **Biometrics and clinical examination**

Specially trained personnel measured non-fasting total cholesterol (mmol / l), blood pressure (systolic / diastolic blood pressure, mean of reading 2 and 3) and body weight and height (kg / m2). The thresholds for high cholesterol (≥ 5.0 mmol/l) and high blood pressure (> 140 / 90 mm Hg) were set according to national guidelines for the prevention of cardiovascular disease [211]. Body mass index (BMI) was categorised as “lean,” (< 25 kg / m2) “overweight” (25-30 kg / m2), or “obese” (≥ 30 kg / m2).

3.3.4 **Self-reported medical diagnoses**

Self-reported physical illnesses were specific medical conditions reported in different surveys: psoriasis, food allergies, chronic bronchitis, migraine, ulcer, asthma, thyroid disease, arthritis, myocardial infarction, cerebrovascular stroke, diabetes, osteoporosis, and angina. We used a validated measure of comorbid burden, the Health Impact Index (HII), which considers that each condition has a different impact on SRH [212]. HII was used as a continuous variable in

the models and categorised as “Not ill” (0), “Mildly ill” (1-2), “Moderately ill” (3-5), and “Seriously ill” (≥ 6) in descriptive statistics.

3.3.5 **Mental distress**

Mental distress was measured with validated questions on degree of anxiety and depression. Tromsø4 used the seven-item Cohort Norway Mental Health Index (CONOR-MHI), whereas Tromsø5-7 used the ten-item Hopkins Symptom Check List-10 (HSCL-10) [213, 214]. The agreement between these questions has been examined with reasonably good compliance [215]. A cut-off of 2.15 for significant symptoms of CONOR-MHI is equivalent to 1.85 for HSCL-10. In sub-study II, the cut-off limit of HSCL-10 ≥ 1.85 was used to dichotomize mental distress: Yes or No. The suggested cut-off limits were used to estimate an ordinal measure of mental distress in sub-study III: "No symptoms" (0), "Some symptoms" (1), "Subthreshold symptoms" (2), and "Significant symptoms” (3).

3.3.6 **Sleeping pills or tranquilisers**

Self-reported use of sleeping pills or tranquilisers during the last two (Tromsø4) or four (Tromsø5-7) weeks was included (not used, less frequently than every week, every week, but not daily, or daily). The response alternatives were dichotomised as “Have used” or “Have not used” sleeping pills / tranquilisers during the last two/four weeks.

3.3.7 **Smoking**

Data on smoking were measured by the questions “Do you / did you smoke daily” and “If you currently smoke, or have smoked before, how many years in all have you smoked daily?” and were subsequently recoded as “Never” (0), “< 20 years” (1), and “≥ 20 years” (2).

3.3.8 **Physical activity**

Physical activity level was estimated as an ordinal variable by the question “How has your physical activity in leisure time been during this last year? Think of your weekly average for the year” and coded as “inactive”(0), “> one hour/week”(1), “1-2 hours/week”(3), and “3 or more hours/week”(3). High- and low-intensity activity levels were collapsed, and the highest number of hours per week was used.

3.3.9 **Self-rated health**

SRH was measured by the following question: “How do you generally consider your own health?”. The response alternatives were coded “bad / very bad / poor”(1), “neither good nor bad / fair”(2), “good”(3), and “excellent”(4).

3.3.10 **All-cause mortality**

Time of death was retrieved from the Norwegian Cause of Death Registry (CoDR). Follow-up time extended from the date of first participation to the date of death, emigration or the end of study follow-up on November 25, 2020. The coverage of the CoDR is almost complete [36].

3.4 Sub-study I: study sample and design

Sub-study I is a repeated cross-sectional examination and was based on Tromsø4 (1994–95), Tromsø6 (2007–08) and Tromsø7 (2015–16). Data were retrieved from participants aged 60 years and over at the time of participation and who answered questions about alcohol consumption. All residents of Tromsø municipality aged 60 years and over were invited to these three surveys, and it is therefore considered to constitute a random sample. Eligible for this study were 5,861 participants (55% women) from Tromsø4, 6,462 participants (53% women) from Tromsø6 and 8,616 participants (52% women) from Tromsø7.

3.4.1 **Study variables**

In sub-study I, we dichotomized drinking frequency to "infrequent" (< 2 times a week) or "frequent" (≥ 2–3 times per week) drinking, as this cut-off limit is used in other comparable studies [7, 34]. Due to some evidence on cut-off limits of at-risk drinking among older adults, we dichotomized drinking quantity to "moderate" (≤ 2 units / ≤ 24 g of ethanol) or "at-risk" (≥ 3 units / ≥ 36 g of ethanol) drinking on typical drinking days [26, 35, 36]. HED was dichotomised to "never" or "ever", due to the fact that HED at least once yearly identifies those at risk of harm from any heavy drinking [28, 33]. Age, educational level and relationship status has been shown to account for some of the sex differences in alcohol consumption, and were included as confounders [34, 86, 125]. Age was measured as a continuous variable and subsequently recoded into two age groups: 60–69 years, and 70 years and older (70–99).

3.4.2 **Statistical analyses**

Since a number of the individuals in this study participated in two (Tromsø4 / Tromsø6 = 1,589; Tromsø4 / Tromsø7 = 583; Tromsø6 / Tromsø7 = 3,975) or all three of the surveys (545), these observations are considered clustered or non-independent. To account for this dependency, we used generalized estimating equations (GEE) for fitting logistic regression models [216]. We specified models, with a logit link function, the correlation structure was set to exchangeable, and we selected robust standard errors. Binary variables of abstainers / drinkers, infrequent / frequent drinkers, moderate / at-risk drinkers, and ever / never HED during the past year were compared across time. Time (1994–95, 2007–08 and 2015–16) was used as an independent variable. 1994–95 was set as reference category in all models, except for HED in age group 70+. The question about HED was asked only to participants aged < 70 years in 1994–95. 2007–08 was thus set as a reference category in the model of older adults 70+, to enable comparison of changes in the prevalence and sex-related

differences among participants over 70 years between 2007-08 and 2015–16 in this drinking category. In order to test for changing sex-related differences between surveys we included an interaction term between sex and survey.

To describe overall changes in drinking patterns in the population of older adults we used unadjusted models. However, age, educational level and relationship status may account for some of the sex-related differences in alcohol consumption, so these variables were included in the models of change in sex-related differences. Furthermore, the change in education level and relationship status differed between the sexes during the study period, separate models were therefore estimated to compare the influence of these covariates. Participants reporting to be abstainers were only included in the category of overall drinking/abstaining, and excluded from analyses of other drinking patterns. The results are reported as odds ratios (OR) with 95 % confidence intervals (95 % CI). Continuous variables are presented as the mean (SD) and categorical variables as counts (%). Prevalence rates, sex-related differences and changes in sex-related differences in abstaining, infrequent/frequent drinking, moderate/at-risk drinking, and any/none HED last year were calculated for the total sample and separately for the age groups 60–69 and 70 + . Changes in educational level and relationship status across time among men and women were compared with Chi-square tests. All analyses were conducted using IBM SPSS, version 26.

3.5 Sub-study II: study sample and design

Sub-study II is a cross-sectional examination and was based on Tromsø7 (2015–16). Data were retrieved from participants aged 60 and older at the time of participation who answered questions about alcohol consumption. All residents of Tromsø municipality aged 40 and older were invited to participate in the survey. Eligible for this study were 8,616 (52 % women).

3.5.1 **Study variables**

In sub-study II, we estimated at-risk and binge drinking prevalence using AUDIT-C and AUDIT-3 thresholds specific to older adults suggested by Towers et al [116]. An AUDIT-C threshold of ≥ 3 for women and ≥ 4 for men defined "at-risk drinking", and an AUDIT-3 threshold of ≥ 1 (i.e., one or more instances of drinking ≥6+ in one session during the past year), to identify older adults with binge drinking habits [150]. In addition, we used AUDIT items 4-10, often labelled AUDIT-P ("P" for problems), to assess any problems related to alcohol use (threshold of ≥ 1) [217]. The AUDIT items 4-10 are; "During the past year, how often have you found that you were not able to stop drinking once you had started; how often have you failed to do what was normally expected of you because of drinking; how often have you needed a drink in the morning to get yourself going after a heavy drinking session; how often have you had a feeling of guilt or remorse after drinking; how often have you been unable to remember what happened the night before because you had been drinking; Have you or someone else been injured as a result of your drinking; Has a relative or friend, doctor or other health worker been concerned about your drinking or suggested you cut down". Due to varying findings of predictive factors for at-risk drinking and HED, we included age, sex, educational level, relationship status, social support/loneliness, SRH, mental distress, and the use of sleeping pills.

3.5.2 **Statistical analyses**

We used logistic regression models to assess the association between the at-risk drinking outcome variables as binary responses and sociodemographic and health characteristics as independent variables. To examine whether the effect of the independent variables differed for men and women, we tested for interaction by including two-way cross product terms in the models. We observed significant interactions between at-risk drinking and most of the independent variables. Thus, all logistic regression analyses were stratified by sex (men and

women). Each drinking category was analysed separately without creating mutually exclusive groups. At-risk drinkers were compared with low-risk drinkers, heavy episodic drinkers with non-heavy episodic drinkers, and participants experiencing some sort of alcohol-related problems with those not experiencing alcohol-related problems. Only participants responding affirmatively to having consumed alcohol during the last 12 months were included in these analyses. Due to the large sample size, listwise deletions for missing values were used. Three sets of logistic regression analyses were conducted to model various categories of at-risk drinking as a function of sociodemographic factors, the perception of having enough social support, the perception of general health, mental distress, and the use of sleeping pills. Associations between the dependent variables and sociodemographic characteristics and selected health variables were investigated first in unadjusted models. Subsequently, we controlled for other variables by building multiple logistic regression models. Age and educational level were significantly associated with all drinking behaviours in both men and women and were included in the final models. The results are presented as odds ratios (ORs) with 95 % confidence intervals (CIs). Levels of significance at both 0.05 and 0.01 are provided in the tables, but given the large sample size, the main findings at the 0.01 level are discussed in the article. Continuous variables are presented as the mean (SD), and categorical variables are presented as counts (%). Chi-square tests were used to assess associations between drinking categories and sociodemographic and health characteristics. All analyses were conducted using IBM SPSS, version 27.

3.6 Sub-study III: study sample and design

Sub-study III uses an accelerated longitudinal design and was based on Tromsø4 (1994–95), Tromsø5 (2001), Tromsø6 (2007–08) and Tromsø7 (2015–16). We excluded subjects who had missing values on alcohol consumption questions, leaving 5,805 (44 excluded), 4,261 (657 excluded), 6,169 (291 excluded), and 8,355 (261 excluded) participants, from each of the

consecutive waves of the Tromsø Study (24,590 observations overall, 53 % women). Modelling of health trajectories required at least two measuring points and thus included 20,840 observations (9,871 in men and 10,969 in women). Overall, 6,050 deaths were recorded in 15,517 unique participants during the study period. Follow-up time extended from the date of first participation to the date of death, emigration or the end of study follow-up on November 25, 2020.

3.6.1 **Study variables**

In sub-study III, we estimated the quantity of alcohol consumption by multiplying the midpoint of each response to AUDIT item 1 by the midpoint of each response to AUDIT item 2, thus generating a volume in grams of ethanol per day. Weekly consumption (g / week) was subsequently recoded as a categorical variable with three levels (abstainers, < 100 g / week, and ≥ 100 g / week), as there is some evidence for a low-risk drinking threshold of 100 g / week [103]. HED (i.e., 6+ in one sitting) was dichotomised, differentiating between participants with frequent (monthly or more often) or infrequent (less than monthly) binge drinking. Due to inconsistent findings on whether women and men have differing health and mortality risks from the same levels of alcohol use, we performed sex-stratified analyses with equal consumption thresholds and controlled for age (continuous) and educational level in all models. A total of 14 covariates were examined as potentially unfavourable or favourable risk factors; age, sex, educational level, relationship status, social support/loneliness, blood pressure, cholesterol, BMI, HII (self-reported medical diagnoses), mental distress, the use of sleeping pills/tranquilizers, smoking, physical activity and SRH.

3.6.2 **Statistical analyses**

We performed the statistical analyses in four stages using STATA, version 17.0.

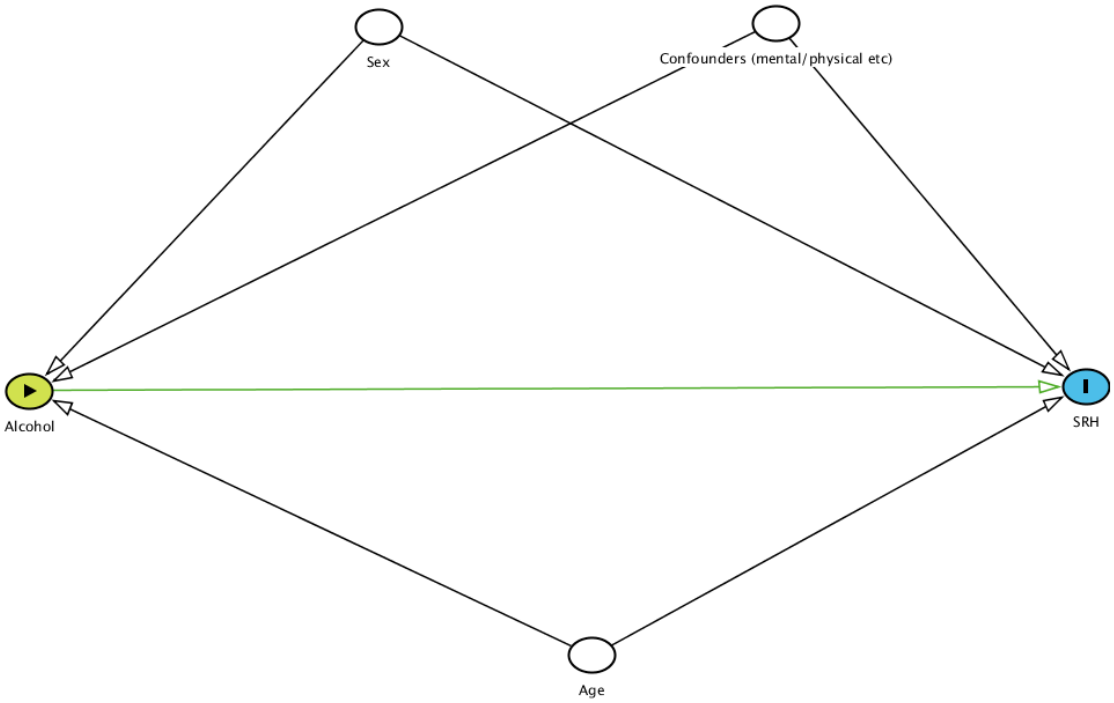
Stage 1: Descriptive characteristics. We examined the characteristics of participants aged ≥60 years who answered questions on alcohol consumption by calculating the variable means, standard deviations, and percentages according to sex and alcohol consumption. We also performed calculations according to the different surveys to convey information on the changes in characteristics over time.

Stage 2: SRH levels across surveys. SHR is not necessarily a stable measure across time. Therefore, we examined the variation in mean values of SRH according to age groups versus drinking thresholds according to each survey. The analytical goal was to disentangle the effect of higher alcohol consumption from the effect of time on SRH. We used cross-tabulation to examine mean levels of SRH according to the drinking groups and stratified for 5-year age groups for each survey. We performed Kruskal-Wallis rank tests to compare SRH according to alcohol consumption across surveys. In addition, we used ANOVA to compare the mean SRH levels for the participants according to alcohol consumption group, stratified into 5-year age groups, and according to the different surveys.

Stage 3: Multilevel random-effects models. SRH is an interesting outcome measure, but it is also an important confounder since it affects both the primary outcome (all-cause death) and participants may adjust their drinking levels according to self-perceived health. SHR is also not necessarily a stable measure between men and women. Furthermore, it is reasonable to assume that men and women may adjust alcohol consumption differently according to their perceived health situation as well as according to other risk factors. Therefore, we examined which factors affect SRH according to sex. We used causal diagrams (DAG) to identify potential confounders and possible interactions. Figure 4 shows the DAG the conceptual model of the effect of alcohol on SRH. A conceptual diagram represents a set of relationships

between variables, with the direction of the arrow representing what we are treating as the direction of causal flow, and denoting which variable is considered predictor (indicated green in Figure 4) and which is considered outcome (indicated blue in Figure 4) in the process we are theorizing [218].

Figure 4 *Directed acyclic graph showing the relationships for the conceptual model of the effect of alcohol on self-rated health:*



From http://www.dagitty.net/dags.html

The multilevel random-effects modelling uses the fact that the data are multiple observations nested in the participants over time. Each participant was followed for two or more measuring points for this analysis. Thus, the participants could enter the study at different time points, and their first measuring point was regarded as the baseline.

We organised the data as panel data and fitted two-level random-effects logistic models for ordered responses (SRH = poor / fair / good / excellent), with drinking level as the predictor variable and with the time-varying covariates of each panel (i) nested within participants (j) [219]. The referent group for all models were low-risk drinkers (< 100 g / week). We included

repeated measurements of covariates based on comprehensive questionnaires, biological samples and clinical examinations. We used an accelerated longitudinal design, which includes multiple single trajectories, each starting at a different time relative to the outcome measures. One of the benefits of this method is its ability to span the age range of interest in less time than would be possible with a single cohort longitudinal design [220]. Random effects were used to cope with the potential bias accelerated longitudinal designs have due to multiple cohorts. The method allowed us to adjust for all the independent covariates across surveys.

The sex-stratified models were built hierarchically, starting with separate models for each risk factor controlled for age and education. We encountered no estimation problems (e.g. improper variance estimates). We checked covariance for all independent variables. The highest correlations were between SRH and somatic diseases (-0.354), SRH and mental distress (-0.336), alcohol consumption and education (0.290), and alcohol consumption and binge drinking (0.284), none of which were considered problematic in the modelling. Insignificant confounders were excluded from the final models (relationship status, binge drinking, hypertension, and hypercholesterolemia). Finally, Figure 5 shows the fully fitted model controlled for all significant independent risk factors. The results of the univariate analysis and the fully fitted models are reported as odds ratios (OR) with 95 % confidence intervals (CI).

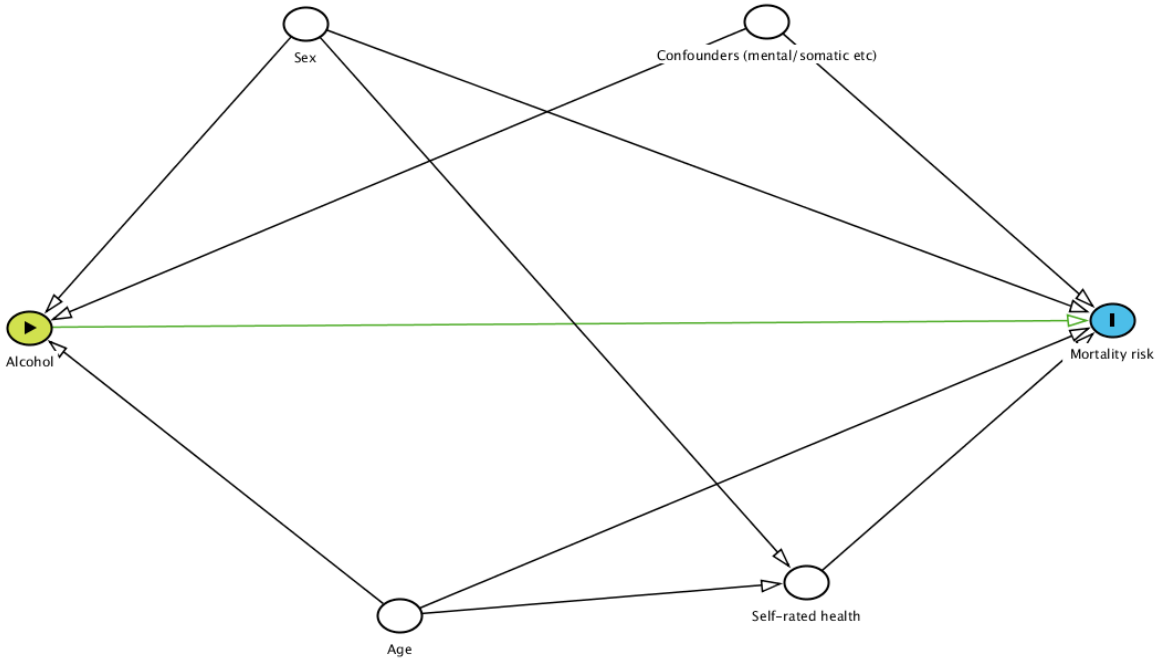
Figure 5 *Final multilevel random-effects models (stratified by sex):*

$$logit\{Pr(SRH_{ij} > s|time_{ij})\} = \beta_1 alcohol_{ij} + \beta_2 mental\ distress_{ij} + \beta_3 somatic\ diseases_{ij} + \beta_4 smoking_{ij} + \beta_5 sleeping\ pills_{ij} + \beta_6 bmi_{ij} + \beta_7 physical\ activity_{ij} + \beta_8 social\ support_{ij} + \beta_9 age_{ij} + \beta_{10} education_{ij}$$

We checked all interactions one by one between each of the risk factors and drinking level in the final model, including the insignificant risk factors, as they may interact with alcohol consumption and affect outcome (SRH), even if they did not reach significance as confounders [218].

Stage 4: Mortality rates and all-cause mortality risk according to alcohol consumption. Initially we calculated the all-cause mortality rates for the three categories of alcohol consumption according to sex during the study period. Then, as in stage 3, we used DAGs to identify potential confounders and possible interactions in the relationship of the effect of alcohol on mortality risk as shown in Figure 6.

Figure 6 *Directed acyclic graph showing the relationships for the conceptual model of the effect of alcohol on mortality risk:*



From http://www.dagitty.net/dags.html

We used Cox proportional hazard models to estimate hazard ratios (HR) and 95 % confidence intervals (CI) of death according to alcohol consumption stratified by sex. The reference group for all models were low-risk drinkers (< 100 g / week). Participants entered and exited

at their age measured in days. Time extended from the age at study entry to the age of death, or end of follow-up on 25 November 2020. The follow-up time was person-age, and the average follow-up time was 11.7 years (range 0.1-26.3 years). All time-varying scores were updated in 2001, 2007-08, and 2015-16 for all participants. The models include repeated measures of alcohol consumption to capture the effect of changes in consumption level over time. We followed the same hierarchical analysis plan as in stage 3. Thus, interaction terms between drinking level and all risk factors were examined consecutively in the fully fitted Cox models.

The proportional hazard assumption was verified for drinking levels by visual inspection of log minus log survival curves and by tests of Schoenfeld residuals (abstainers, p=0.089; drinking ≥ 100 g / week, p=0.225). The visual inspection and the Schoenfeld test indicated that the proportional hazard assumptions were not violated. The results of the univariate analysis and the fully fitted models are reported hazard ratios (HR) with 95 % confidence intervals (CI).

3.7 Ethics

All participants provided written informed consent for participation in the Tromsø Study and to the scientific use of their health survey data. To ensure anonymity according to Norwegian regulations, all names and personal identification numbers were removed from the data files before we received them. The Tromsø Study has a license from the Norwegian Data Inspectorate and has been approved by the Regional Committee for Medical and Health Research Ethics (REK North) and performed in accordance with the 1964 Helsinki declaration and its later amendments. Additionally, this research project is approved by the REC North (case reference 2020 / 96868), see Appendix 1. Furthermore, a decision has been made to make data available from the CoDR (Pr.nr: PDB 3107, case reference 21 / 15163),

see Appendix 2. The project on alcohol and aging is funded by the North Norway Regional Health Authority (Pr.nr: HNF1467-19) and supported by the University Hospital of North Norway (Pr.nr: 22128). Open Access funding for sub-study II is provided by UiT The Arctic University of Norway. The funding organizations were not involved in the design of the study, the data analysis, the interpretation of the results, the writing or the submission of the manuscript.

3.8 Public and patient involvement

Patient and public involvement (PPI) has potential to enhance health-care research and is increasingly an expectation, especially for many funders, including my own funding organization [221]. In planning phase of the research project in this thesis, we consulted the General Manager of the Norwegian users' association in the field of alcohol and drugs (Marborg) and the Deputy Head and Regional Manager in Northern Norway of the Norwegian users' association in the field of alcohol and drugs (RIO). Furthermore, we discussed our preliminary findings in sub-study I with them, and received several important inputs and ideas about the results. Unfortunately, the Covid-19 pandemic reduced our opportunity for more comprehensive cooperation.

4 Main results

4.1 Summary of paper I; The changing alcohol drinking patterns among older adults show that women are closing the gender gap in more frequent drinking: the Tromsø Study, 1994–2016

Due to large variations in findings of prevalence of alcohol consumption and drinking patterns among older adults across European countries, and even between different regions in the same country, including depending on age, sex and time period / cohorts included, we examined trends in alcohol consumption among older adults in a geographically defined area in Norway, especially changing sex differences in drinking patterns over a 22-year period.

We found that the overall abstinence rate among those aged 60 years and older decreased considerably between 1994 and 2016, from 31 % to 11 % (14 % in women and 7 % in men). In the youngest age group (60–69 years), as small a proportion as 5 % of men and 9 % of women reported abstaining from alcohol in 2015–16. The overall prevalence of frequent drinking (drinking at least twice weekly) increased significantly from 9 % in 1994–95 to 35 % in 2015–16. Appendix Figure 7 shows the results from raw data for changes in alcohol consumption according to sex in Tromsø4, 6 & 7.

The probability of reporting frequent drinking increased more among women compared to men (6-8-fold increase compared to 3-4-fold increase). In addition, the prevalence of drinking (≥ 3 units / ≥ 36 g of ethanol per occasion) on typical drinking days increased significantly during the study period among women aged 60–69 years from 16 % to 22 %, and among men from 28 % to 44 % in the age groups 60–69, and from 17 % to 24 % among men 70+ years. Furthermore, we found that a total of 46 % of participants between the ages 60 and 70

reported to drink 6+ in one session on at least one occasion last year in 2015-16 (27 % in women and 66 % in men).

We concluded that among older adults in Norway, alcohol consumption has increased considerably between 1994 to 2016. Compared to previous generations, the new generation of older adults drinks more frequently and consumes larger quantities on typical drinking days, while the prevalence of HED has remained stable. The gap between women and men in frequent drinking has been markedly narrowed, suggesting that women's drinking patterns are approaching those of men.

4.2 Summary of paper II; Sex differences in at-risk drinking and associated factors–a cross-sectional study of 8,616 community-dwelling adults 60 years and older: the Tromsø Study, 2015-16

Due to findings of increased alcohol consumption among older adults, especially among older women, sex differences in associated characteristics (sociodemographic and selected health characteristics) of at-risk consumption in the current cohort were investigated.

We found that the overall prevalence of at-risk drinking among those aged 60-99 years was equal in women and men; 44 % and 46 %, respectively. Among those aged 60-69, 50 % of women and 54 % of men were at-risk drinkers; among 70-79-year-olds, 36 % of both women and men were at-risk drinkers; and among 80-99-year-olds, 24 % of women and 19 % of men were at-risk drinkers. Furthermore, among those who reported any problem associated with alcohol use (AUDIT-P ≥1), a total of 12 % were women and 32 % were men.

At-risk drinking was associated with younger age in both sexes. There were sex differences in the other associated characteristics listed in Table 2.

Both heavy episodic drinking and experiencing some sort of alcohol problem were strongly associated with male sex and lower age. Increasing age, living with a spouse or partner, having enough social support, and better health reduced the probability of alcohol problems in both women and men. Mental distress and the use of sleeping pills were strongly associated with a greater likelihood of alcohol problems in both sexes. Educational level was not associated with any alcohol problems in men, whereas having a college or a university degree was associated with a higher probability of alcohol problems in women. In addition, we identified sex differences in associated abstinence factors, shown in Appendix Table 9.

We concluded that although it is well known that former drinkers often stop consuming alcohol when their health deteriorates, which is known as the "sick quitters effect", our findings indicate that this effect applies especially to women, which supports evidence of gender differences in risky health behaviour.

Table 2 *Factors associated with abstinence, at-risk drinking and alcohol-related problems*[a]

Abstinence		**At-risk drinking (AUDIT-C ≥ 3 / 4)**		**Any alcohol-related problem (AUDIT-P ≥)**	
Women	Men	Women	Men	Women	Men
Older age group	Older age group	Younger age	Younger age	Younger age	Younger age
Lower educational level	Lower educational level	Higher educational level	Higher educational level	College or university degree	
Living alone	Living alone	Living with a spouse or partner		Living alone	Living alone
Not enough friends	Not enough friends	Enough friends		Not enough friends	
Poor SRH		Very good or excellent SRH		Poor SRH	Poor SRH
Mental distress				Mental distress	Mental distress
Use of sleeping pills			Use of sleeping pills	Use of sleeping pills	Use of sleeping pills

[a]Detailed information from adjusted analyses is found in S.Table 1, and Table 3 & 4in sub-study II.

4.3 Summary of paper III; The effects of exceeding low-risk drinking thresholds on self-rated health and all-cause mortality in older adults: The Tromsø Study 1994-2020

Based on findings of increasing alcohol consumption in older adults, we investigated the health-related consequences of exceeding the suggested low-risk drinking thresholds and included repeated measures to control for changes in alcohol consumption and time-varying covariates.

We found that women, but not men, who consumed ≥ 100 g / week had better SRH than those who consumed < 100 g / week (OR 1.85, 95 % CI 1.46-2.34). In addition, we found no clear evidence of an independent negative effect on self-rated health trajectories or mortality for exceeding the suggested low-risk drinking thresholds compared with abstinence or moderate drinking levels over a 25-year follow-up. In Table 3, the significant results from the fully fitted models are listed, with beneficial factors indicated in green and adverse factors indicated in red.

Table 3 *Factors associated with SRH or mortality risk using moderate drinking (< 100 g / week) as reference (OR 1.00)*[a]

	Self-rated health (SRH)		Mortality risk	
	Women (OR)	Men (OR)	Women (HR)	Men (HR)
Abstinence	0.60*** [0.51, 0.72]	0.85 [0.68, 1.07]	1.31*** [1.18, 1.46]	1.18** [1.06, 1.32]
≥ 100 g / week	1.85*** [1.46, 2.34]	1.18 [0.99, 1.42]	0.95 [0.73, 1.22]	0.89 [0.77, 1.03]
Live with a spouse or a partner	No ass.	No ass.	0.81*** [0.74, 0.89]	0.81*** [0.74, 0.90]
Mental distress (cut-off 1.85 / 2.15)	0.05*** [0.04, 0.06]	0.04*** [0.03, 0.06]	1.04 [0.86, 1.26]	1.36** [1.12, 1.66]
Physical illness (HII continuous)	0.77*** [0.75, 0.79]	0.74*** [0.72, 0.76]	1.05*** [1.03, 1.06]	1.07*** [1.05, 1.08]
Smoking >20 years	0.70*** [0.60, 0.81]	0.46*** [0.39, 0.55]	1.67*** [1.50, 1.86]	1.97*** [1.73, 2.24]

Have used pills last 2/4 weeks	0.69*** [0.60, 0.81]	0.70*** [0.57, 0.85]	0.78*** [0.70, 0.87]	0.89 [0.80, 1.00]
BMI, obesity (≥30 kg/m2)	0.47*** [0.39, 0.56]	0.53*** [0.43, 0.64]	0.67*** [0.59, 0.76]	0.64*** [0.57, 0.73]
Average physical activity per week (≥3 hours)	2.25*** [1.81, 2.80]	2.10*** [1.67, 2.65]	0.81** [0.71, 0.93]	0.74*** [0.66, 0.84]
Social support	1.53*** [1.24, 1.90]	1.35** [1.10, 1.66]	No ass.	No ass.

[a]Detailed information from adjusted analyses is found in Table 3, and Table 5 in sub-study III.
Beneficial factors associated with better SRH or decreased mortality risk are coloured green; Adverse factors associated with poorer SRH or increased mortality risk are coloured red

We identified some sex-specific risk factors which in combination with high alcohol consumption led to adverse effects on self-rated health (moderating effects). In men there were the use of sleeping pills or tranquilisers, and ≥ 20 years of smoking, in women there were physical illness and older age.

We concluded that a large proportion of older high-level drinkers' balanced risk factors in Norway are beneficial. Furthermore, our study does not provide evidence to support sex and / or older adult-specific recommendations for drinking thresholds in a general population of older adults.

5 Discussion

5.1 Methodological considerations

5.1.1 Internal validity

Internal validity is defined as the degree to which inferences drawn from a study are valid in relation to what is measured in the study sample [222]. It refers to whether the study sample, the collection of data, the measures, the design of the study, and the analyses are satisfactory for answering the initial aims of the study. It is determined by how well a study can exclude alternative explanations for its findings (e.g., sources of systematic error or bias). Thus, internal validity is a necessity for extrapolating the results from a study into external validity or generalizability. The various elements that determine internal validity will be discussed for the three sub-studies in the sections below.

Selection bias

Selection bias is systematic error due to a non-random sample of a population, causing some members of the population to be less likely to be included than others [222]. This results in a biased sample, in which all participants are not equally balanced or objectively represented. The effect can be that the relation between exposure and outcome will be different for those who were included in the study and those who theoretically could have participated. There has been a decline in attendance over the four waves of the Tromsø Study, as found in other comparable health surveys in Norway, except very high attendance rates in Tromsø5 [3, 201, 203, 223]. Only participants who had participated in an extended examination in Tromsø4 were invited to Tromsø5. The attendance rate has been found to be higher among those who have taken part in previous surveys than in those who are invited for the first time [201]. Due to concerns regarding selection bias, we excluded Tromsø5 from sub-study I, since estimating prevalence of alcohol consumption in the general population was the main goal. However, we

included Tromøs5 in sub-study III, to increase the power of the analyses that necessitated repeated measurements. Furthermore, due to the central limit theorem, which states that the distribution of a sample variable approximates a normal distribution (i.e., a "bell curve") as the sample size increases [222], we decided that the inclusion of a somewhat healthier sample from Tromsø5 would not bias the results to a large extent. Table 4 shows total participation rates for individuals aged 60 years and older in Tromsø4-7.

Table 4 *Participation rates in Tromsø4-7 among older adults ≥ 60 years*

Tromsø4 (1994-95)						
Age group	Invited men	Invited women	Participated men	Participated women	% men	% women
60-69	1,716	1,825	1,487	1,634	86.7	89.5
70-79	1,216	1,548	935	1,240	76.9	80.1
80+	414	934	214	411	51.7	44.0
Tromsø5 (2001)						
Age group	Invited men	Invited women	Participated men	Participated women	% men	% women
60-69	1,381	1,603	1,248	1,463	90.4	91.3
70-79	1,012	1,310	885	1,099	87.5	83.9
80+	162	214	118	150	72.8	70.1
Tromsø6 (2007-08)						
Age group	Invited men	Invited women	Participated men	Participated women	% men	% women
60-69	2,702	2,635	1,995	2,108	73.8	80.0
70-79	1,197	1,456	841	988	70.3	67.9
80+	492	831	196	335	39.8	40.3
Tromsø7 (2015-16)						
Age group	Invited men	Invited women	Participated men	Participated women	% men	% women
60-69	3,543	3,586	2,502	2,677	70.6	74.6
70-79	1,897	2,001	1,315	1,361	69.3	68.0
80+	723	1,223	348	413	48.1	33.8

Non-participation analysis from the Tromsø Study have shown that subjects who did not attend tended to be single, younger, had higher mortality and there was a higher proportion of men among non-attendees [3]. Others have found that nonparticipants in population surveys have lower socioeconomic status, higher mortality, higher prevalence of several chronic diseases (e.g., cardiovascular diseases, diabetes mellitus and psychiatric disorders), and a

higher prevalence of alcohol misuse [223-225]. Findings from our studies may therefore have been affected by selection bias, with a healthier sample than in the general population and have thus included those who tolerate alcohol well and consequently underestimated adverse effects. Additionally, a higher prevalence of alcohol misuse among non-attendees may have added to such bias, and increased the underestimation of the harmful effects of alcohol.

Non-responder bias

A major concern in epidemiological studies is non-responder bias, which may compromise the validity of the study. In this thesis, non-responders on alcohol questions were excluded (n = 1,246). The largest proportion of non-responders was from Tromsø5, and thus non-response bias has most likely not affected sub-study I & II. Table 5 shows that overall, more women than men were non-responders. Non-responders were also older, had lower levels of education, reported poorer health, were less socially satisfied, and a considerably larger proportion reported to use sleeping pills or tranquilizers. This has most likely affected the prevalence of older adults using such pills in our study, which has resulted in an underestimated proportion in our sample than in the general population. The non-responder bias may also have led to an overestimated proportion of frequent alcohol consumption in our study, due to healthier and higher educated responders, both of which are factors related to increased alcohol consumption. However, due to higher prevalence of past 12 months, chronic risky, acute risky and heavy monthly alcohol use among non-responders, it is not certain that this has led to actual biased results overall [224].

Table 5 *Characteristics of the participants ≥60 not responding to the alcohol consumption questions in Tromsø4–7 (n= 1,246)*

	Non-responders		Responders	
	Women	Men	Women	Men
	n (%)	n (%)	n (%)	n (%)
Total	796 (63.9)	450 (36.1)	12,998 (52.9)	11,592 (47.1)
Wave				
Tromsø4	23 (2.9)	20 (4.4)	3,212 (24.7)	2,593 (22.4)

Tromsø5	424 (53.3)	232 (51.6)	2,260 (17.4)	2,001 (17.3)
Tromsø6	191 (24.0)	99 (22.0)	3,237 (24.9)	2,932 (25.3)
Tromsø7	158 (19.8)	99 (22.0)	4,289 (33.0)	4,066 (35.1)
Self-rated health				
Poor	50 (6.7)	31 (7.4)	719 (5.6)	566 (4.9)
Fair	334 (45.1)	170 (40.7)	5,279 (40.8)	4,053 (35.1)
Good	321 (43.3)	200 (47.8)	5,942 (45.9)	6,043 (52.3)
Excellent	36 (4.9)	17 (4.1)	995 (7.7)	892 (7.7)
Age group				
60-64 years	157 (19.7)	70 (15.6)	4,131 (31.8)	3,861 (33.3)
65-69 years	173 (21.7)	94 (20.9)	3,391 (26.1)	3,192 (27.5)
70-74 years	180 (22.6)	99 (22.0)	2,513 (19.3)	2,347 (20.2)
75 years and older	286 (35.9)	187 (41.6)	2,963 (22.8)	2,192 (18.9)
Educational level				
Elementary school (up to 10 years)	481 (74.9)	230 (66.5)	7,170 (55.6)	4,653 (40.4)
High school (up to an additional three-four years)	120 (18.7)	81 (23.4)	3,105 (24.1)	3,524 (30.6)
College/university, short and long	41 (6.4)	35 (10.1)	2,618 (20.3)	3,335 (29.0)
Relationship status				
Live with a spouse or a partner	354 (53.0)	285 (75.2)	7,217 (60.7)	9,058 (81.5)
Live alone	314 (47.0)	94 (24.8)	4,670 (39.3)	2,058 (18.5)
Enough friends and social support				
No	128 (18.8)	75 (20.0)	1,337 (11.0)	1,223 (11.1)
Yes	552 (81.2)	300 (80.0)	10,800 (89.0)	9,773 (88.9)
Average physical activity per week				
Inactive	113 (19.3)	61 (17.9)	1,806 (14.2)	1,240 (10.9)
<1 Hour	97 (16.6)	61 (17.9)	2,178 (17.2)	2,306 (20.2)
1-2 hours	173 (29.5)	99 (29.0)	4,056 (31.9)	3,374 (29.5)
≥3 hours	203 (34.6)	120 (35.2)	4,659 (36.7)	4,505 (39.4)
Health impact index (HII)				
Not ill (HII=0)	275 (34.5)	190 (42.2)	4,572 (35.2)	5,574 (48.1)
Mildly ill (HII=1-2)	190 (23.9)	126 (28.0)	3,806 (29.3)	3,164 (27.3)
Moderately ill (HII=3-5)	191 (24.0)	83 (18.4)	2,891 (22.2)	2,042 (17.6)
Seriously ill (HII≥6)	140 (17.6)	51 (11.3)	1,729 (13.3)	812 (7.0)
Body Mass Index				
Lean (<25 kg/m2)	291 (36.7)	165 (37.1)	4,768 (36.8)	3,535 (30.6)
Overweight (25-30 kg/m2)	315 (39.8)	201 (45.2)	5,251 (40.5)	5,857 (50.6)
Obese (≥30 kg/m2)	186 (23.5)	79 (17.8)	2,935 (22.7)	2,179 (18.8)
Blood pressure				
< 140/90 mmHg	313 (39.5)	190 (42.5)	5,596 (43.1)	5,269 (45.5)
≥ 140/90 mmHg	480 (60.5)	257 (57.5)	7,380 (56.9)	6,312 (54.5)
Total cholesterol				
< 5.0 mmol/l	105 (13.3)	132 (29.7)	1,800 (13.9)	3,268 (28.3)
≥ 5.0 mmol/l	684 (86.7)	313 (70.3)	11,144 (86.1)	8,295 (71.7)
Smoking status				

Never smoked	329 (51.4)	83 (22.9)	4,953 (42.5)	2,717 (24.3)
>1-20 years	70 (10.9)	47 (12.9)	1,823 (15.6)	1,880 (16.8)
≥20 years	241 (37.7)	233 (64.2)	4,882 (41.9)	6,565 (58.8)
Mental distress				
No symptoms	148 (29.3)	134 (41.6)	2,735 (22.1)	4,003 (35.4)
Some symptoms	187 (37.0)	134 (41.6)	5,614 (45.4)	5,118 (45.2)
Sub-threshold symptoms	119 (23.6)	41 (12.7)	2,829 (22.9)	1,707 (15.1)
Significant symptoms	51 (10.1)	13 (4.0)	1,182 (9.6)	483 (4.3)
Use of sleeping pills/tranquilizers				
Not used last 2/4 weeks	427 (53.6)	313 (69.6)	9,948 (76.5)	10,179 (87.8)
Have used last 2/4 weeks	369 (46.4)	137 (30.4)	3,050 (23.5)	1,413 (12.2)

The findings regarding mortality in sub-study III might have been affected by both selection bias and non-responder bias. Non-participants had higher mortality rates than participants [3]. Moreover, Table 6 shows that non-responders to alcohol questions had higher mortality rates than those who consumed both moderate and high levels of alcohol, and seems to resemble those who are abstainers. Thus, as already mentioned in the two previous sections, we have most likely included a healthier sample in our study than in the general population and may have underestimated the adverse effects of alcohol consumption, including "the sick quitters' effect".

Table 6 *Mortality rates according to alcohol consumption and among non-responders to alcohol questions in subjects aged ≥60 years in the Tromsø4-7*[a]

	Person Time (Years)	**Mortality rate**	**Survival time (Years)**		
			25%	50%	75%
Female abstainer	28,174	0.0486	9.5	16.3	23.0
Male abstainer	10,268	0.0595	6.9	13.8	21.0
Female moderate drinker (< 100 g / week)	66,260	0.0253	14.4	20.7	.
Male moderate drinker (< 100 g / week)	59,667	0.0346	11.2	18.0	24.0
Female high-level drinker (≥ 100 g / week)	5,517	0.0152	15.5	22.8	.
Male high-level drinker (≥ 100 g / week)	10,499	0.0232	13.4	19.6	25.7
Female non-responder	8,756	0.0381	10.7	16.5	22.2
Male non-responder	4,154	0.0594	6.80	12.5	18.6

[a]Detailed information from adjusted analyses is found in Table 4 in sub-study III.

Information bias and self-reported measures

Information bias involves the misclassification of the exposure or outcome resulting in under or overestimation of exposure or outcome prevalence, and is one of the most common sources of bias that affects the validity of health research [226]. It originates from the approach that is utilized to obtain study measurements. Self-reporting is a common approach for gathering data in epidemiologic research, and bias can arise from social desirability, recall period, sampling approach, or selective recall [226-228]. In this thesis, the questionnaires on alcohol consumption differed to some extent between the four waves of the Tromsø Study. Alcohol studies based on self-reporting questionnaires, are often considered a problem due to underreporting as a result of social desirability [227, 229], especially in older adults [230, 231]. Coupled with this, those who drink alcohol often have problems assessing what constitutes a standard drink with over-pouring as the norm, which increases the problem of underestimating consumption [95]. Recall bias is also a source of misclassification bias, especially among older adults due to cognitive impairment [114, 123]. Table 7 gives a comprehensive description of the measurements of alcohol consumption and how they were operationalized for comparability across waves.

Table 7 *Classification of alcohol outcome measures in Tromsø4-Tromsø7*

Outcomes	Tromsø4 (1994-1995)	Tromsø5 (2001)	Tromsø6 (2007-08) and Tromsø7 (2015-16)
Abstinence (AUDIT-C, item 1)	Q1: Are you a teetotaller? (Yes, No) Abstaining = Yes	Q1: Are you a teetotaller? Abstaining = "Yes" on Q1 or responded "Never consumed alcohol" or "Not during the last year" on Q2	How often do you drink alcohol? (Never, Monthly or less, 2-4 times a month, 2-3 times a week, 4 times a week or more) Abstaining = Never
Alcohol consumption, frequency[a] (AUDIT-C, item 1)	Q2: How many times a month do you normally drink alcohol? Do not count low-alcohol beer	Q2: Approximately, how often have you during the last year consumed alcohol?	How often do you drink alcohol? (Never, Monthly or less, 2-4 times a

	(2.5% ethanol). Put 0 if less than once a month (Open question) Q2: Mean: 2.62 (SD 4.80)	(Never consumed alcohol, Not during the last year, A few times, 1 time per month, 2-3 times per month, 1 time per week, 2-3 times per week, 4-7 times per week) Monthly or less = A few times, 1 time per month 2-4 times a month = 2-3 times per month, 1 time per week 2-3 times a week = 2-3 times per week 4 times a week or more = 4-7 times per week	month, 2-3 times a week, 4 times a week or more)
Alcohol consumption, quantity[b] (AUDIT-C, item 2)	Q3-5: How many glasses of beer, wine or spirits do you usually drink in the course of two weeks? Do not include low-alcohol beer. Write 0 if less than once a month. (Open question) Q3: Beer: Mean 0.93 (SD 3.33) Q4: Wine: Mean 1.11 (SD 2.93) Q5: Spirits: Mean 1.36 (SD 3.15).	Q3: When you drink alcohol, how many glasses or drinks do you normally drink? (Open question) Recoded as 1-2 = 0-2 (but "No" on Q1) 3-4 = 3-4 5-6 = 5-6 7-9 = 7-9 10 or more = ≥10	How many units of alcohol (one beer, a glass of wine, or a drink/spirits) do you usually drink when you drink alcohol? (1-2, 3-4, 5-6, 7-9, 10 or more)
Heavy episodic drinking (HED)[c] (AUDIT-C, item 3)	Q6: Approximately how often during the past 12 months have you drunk alcohol corresponding to at least five bottles of beer, a bottle of wine or a quarter of bottle of spirits? (Not at all the past year, A few times, Once or twice a month, Once or twice a week, Three or more times a week")	Q4: Approximately how many times during the last year have you consumed alcohol equivalent to five glasses or drinks within 24 hours? (Open question) Sub-study III; frequent / infrequent HED = responded ≥ / < 12 times	How often do you drink 6 units of alcohol or more in one occasion? (Never, Less than monthly, Monthly, Weekly, Daily or almost daily)

[a]The categorization according to the AUDIT item 1 were estimated for Tromsø4 as follows:

- "Never" = responded "Yes" to the question "Are you a teetotaller"
- "Monthly or less" = responded 0 or 1 time to the question "How many times a month do you normally drink alcohol" but responded "no" to the question "Are you a teetotaller"
- "2-4 times a month" = responded 2-7 times to the question "How many times a month do you normally drink alcohol"
- "2-3 times a week" = responded 8-15 times to the question "How many times a month do you normally drink alcohol"
- "4 times a week or more" = responded ≥ 16 times to the question "How many times a month do you normally drink alcohol"

[b]The categorization according to the AUDIT item 2 were estimated for Tromsø4 as follows:

- The monthly number of alcoholic units consumed was estimated by adding together the beverage units (beer, wine, spirits) reported in a usual two-week period, multiplied by two (to have monthly consumption).
- To estimate number of alcohol units on typical drinking days, the overall monthly consumption was divided by the reported monthly frequency of alcohol consumption.

[c]The categorization according to the AUDIT item 3 were estimated for Tromsø4 as follows:

- Response alternatives were dichotomized in sub-study I to "Never" or "Ever" HED during the past year, and in sub-study III to "Frequent" = " Once or twice a month", "Once or twice a week", or "Three or more times a week" or "Infrequent" = "Not at all the past year" or "A few times". The heavy episodic drinking question was only asked to persons < 70 years in Tromsø4.

Although precaution was taken to operationalize the measures for comparability across surveys in sub-study I & III, differing questions on how alcohol consumption was assessed may have introduced some misclassification bias. Open-ended questions about frequency and volume (as in Tromsø4 &Tromsø5), without categorical response options (as in Tromsø6 and

Tromsø7), may have increased the tendency to underestimate self-reported alcohol consumption in Tromsø4-5 due to social desirability bias. On the other hand, more liberal attitudes towards alcohol use in old age have been reported, which may have reduced stigma and shame and resulted in less underreporting in recent surveys, and thus possibly counteracted this bias [49, 81].

Furthermore, the validity of using an AUDIT-C threshold of ≥ 3 / 4 for "at-risk" drinking (as in sub-study II) in older adults is controversial, and some researchers claim that it is too low [209, 232, 233]. Poor sensitivity of a measure results in overestimation of prevalence. Others maintain that even if there is a risk of overestimation of prevalence, utilizing both sex and older adult-specific thresholds more validly identifies at-risk drinkers [101, 116]. However, we did not aim to conclude whether those exceeding an AUDIT-C threshold of ≥ 3 / 4 were risky drinkers, even if a strong correlation between an AUDIT-C score of ≥ 3 for older women and ≥ 4 for older men and exceeding the alcohol consumption limits recommended by the NIAAA has been shown [210]. We therefore consider these thresholds precise enough to elucidate on the questions in sub-study II.

Several issues are sources of misclassification bias also in sub-study III. The abstinence group most likely consists of both lifelong, past and current abstainers, introducing problems with reversed causality and the aforementioned "sick quitters effect". However, we did not use the abstainer group as a reference group. Thus; this is not considered to reduce the validity of the results when comparing moderate and high-level drinkers. Moreover, to categorize alcohol consumption into only three groups is indeed an imprecise measure. Nonetheless, it was not within the scope of our study to investigate *whether* alcohol is healthy or to determine a "nadir" threshold for low-risk drinking among older adults. We were interested in examining the independent effect of exceeding suggested low-risk threshold in old age, and whether we were able to elucidate for whom it may be more harmful to exceed such drinking thresholds.

In the trade-off between more accurate drinking groups and increased power in the statistical modelling, we chose the reported categorization. All things considered, misclassification bias is important to appraise when conclusions are to be drawn from the three sub-studies in this thesis. However, in order to answer the questions in our main aims, information bias is assumed to have contributed only to a small extent to reducing the validity of results.

Confounding and interaction

A confounder can be defined as a common cause of exposure and outcome, while a moderator (interaction) is related to the magnitude of the effect of the exposure on outcome [218]. Statistical models control only for known and measured confounders. In the planning phase of this project, we used causal diagrams (DAG) to identify potential confounders and possible interactions. In sub-study I, we decided to include age, sex, educational level and relationship status to investigate consumption trends, due to prior knowledge that these were certain confounders. However, there might have been other confounding factors that have not been adjusted for. In addition, we did not include an age-period-cohort interaction in our models in sub-study I, and thus the cohort effect on the changing alcohol consumption was not possible to estimate.

When the question motivating a study asks under what circumstances (or for whom, e.g., according to sex, mental distress, age etc.) an exposure exerts an effect on the outcome, moderation analysis is an appropriate analytic strategy. We performed interaction analysis in all three sub-studies to examine whether the effect of the independent variables differed for men and women. We observed significant interactions in all sub-studies and decided to stratify the subsequent analysis models according to sex. There is a lack of studies comparing alcohol consumption, associated factors and health-related consequences between older men and women, and thus we decided to perform all the analyses stratified according to sex in all

three sub-studies. However, this limits the potential for direct comparison of effect sizes between the sexes, which could also have been of importance.

In sub-study III, we only included the significant interactions in the final models. This may not be entirely correct, since relevant interactions can be limited to certain intervals for an exposure or outcome variable, and thus not reach significance in less advanced techniques [218]. Furthermore, we have not investigated mediation models, although several of the covariates are likely to be mediating some part of the outcome results [234]. Nevertheless, in the trade-off between too many variables (overfitting), models and interaction terms, we decided to follow the plan described in section 3.7. Therefore, potential residual confounding cannot be ruled out in all three sub-studies.

Moreover, genetic factors are not considered in the present work. However, even genetic studies, utilizing mendelian randomization for evaluating effects of alcohol on health-related outcomes, have concluded that however accurate an estimate of average intake is, this measure is insufficient to study the relation, as many environmental and lifestyle factors are important in modifying the health effects of drinking, and must be considered when making conclusions on the relationships between alcohol consumption and health-related outcomes [174, 175, 235].

Study design

A major strength of our study is that it included a long follow-up period of up to 25 years. In sub-studies I & III, we utilized the longitudinal design with repeated measurements. In addition, the repeated surveys of a general population located within the same geographic area, strengthen the probability of reliable estimates of change and comparisons across age groups and sexes. The large sample size also made it possible to control for a range of variables that could confound the associations in sub-study III.

Findings on alcohol consumption based on cross-sectional data, are often interpreted as age-related changes. However, results could be due to time-period or cohort effects as well. A longitudinal study design is usually beneficial, but it can be difficult to distinguish age-period-cohort effects. The discrepancy between cross-sectional and prospective findings across alcohol studies have been suggested to be a result of birth cohort effects [125]. Sub-study III utilized an accelerated longitudinal design. The trade-off for this design is the inherent missing data. By design, each subject's measurement covers only part of the age range of interest. This can be a considerable problem when there is an age-cohort effect, that is a systematic difference between participants born at different times [220]. Examining findings by estimating formal age-period-cohort models can elucidate such discrepant results. In sub-study III, we investigated mortality risk in separate analyses for participants born before and after 1946 to compare the effect of exceeding 100 g / week in baby boomers, with the "dry" pre-world war II generation. The results were qualitatively equivalent in the two cohorts, although the premature mortality risk in the abstaining baby boom women was more significant than in the pre-world war II women. From examining the findings of wider CI bands in mortality risk by alcohol consumption in the baby boom cohort than in the pre-world war II cohort, we cannot rule out that this difference also implies a change in mortality risk due to changed alcohol habits in the younger cohort of older adults. A greater proportion among the youngest cohort have increased alcohol consumption, and as the general level of consumption in a population increases, the prevalence of heavy or harmful use increases [44, 50]. However, the findings might also be explained by biases introduced by the study design, i.e., shorter follow-up time in a greater proportion of the younger cohort, resulting in greater heterogeneity and residual aging and period confounding effects.

Sub-study II had a cross-sectional design, as we wanted the most recent data because the population characteristics are constantly changing. However, the interpretation of correlated

findings is challenging due to difficulties in determining the direction of the associations. A prospective longitudinal design could have further broadened the understanding of the directions of relationships between risk factors and risk drinking. Nevertheless, the sample size was large and allowed for precise prevalence estimates of at-risk alcohol consumption among the current cohort of older adults. In addition, the findings of associated characteristics were in line with several recent studies among older adults in west European countries, which strengthens our inferences. Even so, polypharmacy and comorbidity are major concerns in combination with elevated alcohol consumption [89]. We did not have access to data on self-reported medications other than sleeping pills, and decided to include SRH as a proxy of health status instead of using self-reported medical illnesses in sub-study II. This implies a limitation in the interpretation of the results.

5.1.2 **External validity**

External validity is defined as the extent to which findings can be generalized to other contexts, i.e., to a wider population from which the sample came (different measures, persons, settings and times) [222]. The study sample is drawn from the inhabitants of the seventh largest Norwegian city with relatively few immigrants, and it is limited in terms of cultural differences related to religion or ethnic diversity. In addition, the establishment of large educational and health institutions and other knowledge-based industries in the 70s and 80s, has led to a highly educated population, which in turn may have biased the sample towards higher alcohol consumption than in the general population [203]. Furthermore, the sample does not include rural living older adults, and as noted in section 1.3, this may also have biased the results towards higher alcohol consumption. Correspondingly, alcohol sales figures are higher in Tromsø and the neighbouring municipality of Tromsø (Balsfjord) than average sales figures in Norway [204]. Moreover, Norwegian older adults have greater financial security, better health and welfare systems, and less social and gender inequality than in the

US and many other European countries, which may increase the availability and possibility of higher alcohol consumption [81]. Furthermore, as described in section 5.1.1, the sample is likely to be healthier than the general population. On the other hand, the Tromsø Study is based on relatively high participation rates and the sample size is large [3]. All things considered, the generalizability of results may therefore be limited to Caucasian populations similar to older adults of Northern European descent, and may also be restricted to urban living older adults [201].

5.1.3 Statistical considerations

Alcohol consumption was not normally distributed but rather left skewed. However, alcohol consumption was categorized in all three sub-studies, to enable for comparison between strength of association of different categories of alcohol consumption across time (sub-study I), characteristics (sub-study II) and SRH / mortality (sub-study III). The central limit theorem states that samples consisting of more than 30 participants are reasonable large, and that in such samples the mean is often normal, even if skewness occurs [222]. This rationale is strengthened as sample size increases.

In sub-study I, we used GEE analysis to estimate trends across time. GEE is well suited for handling non-normally distributed variables [216]. GEE analysis is also well suited for longitudinal analyses because it accounts for correlations within individuals, i.e., that the responses from the same individual across time tend to be "more alike" than between subjects, and also because it estimates changes and trends for the missing values at each time point. Nevertheless, GEE analysis assumes that the missing values are missing at random, and this might have caused some biases in the estimates, if this assumption was not correct.

In sub-study II, we used logistic regression models to assess the association between the at-risk drinking outcome variables as binary responses and sociodemographic and health

characteristics as independent variables. This statistical method is considered to be suitable for answering the aims of a cross-sectional study. However, we used the default setting in SPSS for logistic regression models, using listwise deletions for missing values. If the deleted cases due to missing values were not missing at random, listwise deletion may have caused some biases in the estimates [236].

In sub-study III, we used multilevel random-effects analysis to assess the association between three levels of alcohol consumption and SRH [219]. The sample size was large, and thus the power was strong. However, modelling of health trajectories required at least two measurements, which may have biased our findings towards healthier participants. Nevertheless, the methodology ensures that data are not wasted for participants and occasions for which either the response or the covariates are missing, in contrast to more old-fashioned approaches such as listwise deletion or complete case analysis. Use of all available data is less susceptible to bias. In addition, we included the total sample in our survival models, and did not exclude participants who died during the first year after inclusion to control for those who were already ill. We did, however, perform sensitivity analyses in sub-study III, and achieved similar hazard ratio results when we excluded participants who died within the first year. This strengthens the validity of our findings.

5.2 Discussion of main results

The main aims of this thesis were to investigate alcohol trends in a general population of older adults during the past decades and associated characteristics, including sex-related differences. Furthermore, the aim was to examine whether high-level alcohol consumption was an independent risk factor for poorer health or mortality, after controlling for sociodemographic and health-related covariates. In addition, to quantify the extent to which the effect of exceeding low-risk drinking thresholds combined with selected risk factors lead to later consequences; i.e., whether subgroups have increased health risks due to high alcohol consumption. As the results have already been discussed in the three included papers, I aim to review the findings with a wider perspective in this section and reflect on how the results can have implications on further research, clinical practice and future interventions aiming at reducing potential harmful drinking among older adults.

5.2.1 Alcohol consumption: Increased consumption and reduced gender gap

In line with an increasing amount of evidence, we identified a large increase in alcohol consumption during the study period, but a significantly larger increase among older women than older men. Consequently; women's drinking patterns appear to approach those of men, which is consistent with other studies [17, 33, 34, 84, 112, 140, 164, 178, 237, 238]. However, to the best of our knowledge, our findings of as little as 5 % of men and 9 % of women who reported abstaining from alcohol in 2015–16 in the age group 60-70 years is the lowest abstinence rate reported in any survey among older adults. Furthermore, the overall prevalence of at-risk drinking among those aged 60-99 years was 44 % in women and 46 % in men in 2015-16, which is also among the highest proportions reported among older adults [239]. These findings are likely to be related to several factors. As described in section 1.2.1, a cohort effect from the baby boomers has probably also affected Norwegian older adults [74, 79, 119, 240]. Also, the supply of cheaper alcoholic beverages through cross-border and

international tax-free shopping has increased, as has the number of alcohol outlets in Norway [22, 26]. Moreover, there may be an increasing mimicking of the drinking culture from Mediterranean countries, since older adults have increased their travelling frequency to these countries during the study period [26, 33]. Last, but not least; more liberal attitudes towards alcohol have probably influenced older people in Norway, including the perception of alcohol as "healthy" for older adults [30, 47, 49, 50, 59, 148].

Our findings of substantial sex convergences in most alcohol measures among older adults are larger than reported in several other European countries [30-32, 34, 86]. However, they are in accordance with those reported from the multinational GENACIS project (Gender, Alcohol, and Culture: An International Study), showing that Norwegian gender differences are smaller than gender differences in most countries in the world [34]. They are also well in line with findings from the HUNT study (a similar population study from a different County in Norway) [33, 90, 130].

Sex is defined as the biological differences between people who are male or female, whereas gender is defined as social constructs as gender "roles" or "norms", which occur in a historical and cultural context and vary across societies and over time [241]. Social norms and gender role differences affect drinking habits, thus, the findings regarding determinants of at-risk drinking based on gender vary considerably between countries [17, 84, 128, 130]. As described in section 5.1.2, Norway has greater gender equality than any other high-income country in the world [88], which is linked to increasingly equal levels of binge drinking and risk drinking between men and women [34, 81, 127, 128]. Some evidence also indicates that the effect of retirement on alcohol drinking patterns is somewhat different between the genders among the baby boomers. Men seem to maintain their levels of consumption, and also reduce HED, whereas women, especially those with high workplace stress pre-retirement, tend to drink more after retirement [32, 242]. In line with this, retirement has been

shown to be correlated with an increased risk of unhealthy drinking over time among women, whereas this was not the case among men [131]. Moreover, a recent qualitative study found that older women found it acceptable to use alcohol to temporarily manage stress due to life transitions such as retirement [243]. On the other hand, being employed is associated with more binge drinking among women than not being employed, and women in Norway have increased their work participation during the past decades [24]. To summarize, women in the current and future generation of older adults in northern European countries appear to have as high a risk of hazardous drinking as men. In light of our findings, the sex and gender perspective is essential to understand individuals` health related behaviour in older adulthood [244].

5.2.2 At-risk consumption and abstinence: sex differences in associated factors

Educational level

In accordance with previous research, we found a strong correlation between higher levels of education and higher alcohol consumption, which was even stronger in women than men [51, 105, 129-131, 239]. A strong relationship between higher socioeconomic status and potentially harmful drinking might be perceived as a paradox in light of the perception of successful older adults as well as the new paradigm of healthy aging [147]. Additionally, it has been shown that the detrimental effects of alcohol misuse on mental health applies equally to lower and higher social status groups [149]. Thus, in spite of the alcohol-harm paradox, highly educated and privileged older adults are not exempt from risk of adverse health consequences of excessive alcohol consumption [134-137]. As described in section 1.2.1, even more older adults in future generations will have a high level of education, and this applies especially to women [83]. This may further rise the public health concerns.

In contrast to previous findings, we did not find that alcohol problems were associated with lower educational level [4, 105, 137]. On the contrary, we found an association between the highest level of education (college or university degree) and alcohol problems in women, but not in men. Similarly, some studies of cultural gender differences have found that both risk drinking and heavy drinking were associated with lower educational levels among older men, but higher educational levels among older women [128, 245]. Alcohol misuse may therefore still be a hidden problem that is under-detected because it is not expected in these otherwise successful older adults and especially not among women.

In line with previous findings, we found that abstinence from alcohol was associated with lower educational attainment and poor health (women) [4, 105, 137]. The non-drinking group might contain both "sick quitters" and never drinkers, as discussed in section 5.1.1, but typically consist of individuals in poor health [110, 168].

Social support & spouse / partner

In accordance with other evidence, we found that having a satisfactory social network and living with a spouse / partner were predictors of at-risk drinking among current older adults [105, 123, 145-147]. However, we found gender differences also in this context. In line with others, we found that alcohol-related problems were associated with living alone, but in contrast to other findings, this also applied to women in our study [24, 30, 51, 131, 140-142]. Conversely, not having a satisfactory social network and living alone were predictors of abstinence in both women and men, which has also been found by others among baby boomers [132, 151].

Despite the aforementioned problems of interpreting the direction of associations in sub-study II, our findings may indicate that older women in Norway drink more socially than men, while a subgroup living alone experience more alcohol-related consequences than those who

don't. The prevalence of at-risk drinking among older, highly educated women has increased considerably, and according to Skog's theory, this will lead to an increased proportion of very heavy drinkers in this group [44, 50, 246]. We do not know the direction of associations among those being highly educated, not having enough friends, and experiencing alcohol-related problems. Nonetheless, a subgroup of older women may drink heavily due to little social support, or vice versa; an unsatisfactory social network may be a consequence of inappropriate alcohol use. However, both the existing literature and our findings suggest the last explanation, since women tend to stop drinking if they have too few friends and increase drinking if it is the opposite [105, 132, 145-147, 151]. This suggests that an increasing proportion among heavy drinking women may experience similar problems as men, since heavy drinking may contribute to social isolation and depressive symptoms [51, 164]. From examining the literature, hazardous alcohol consumption may be linked to loneliness and social engagement in complex ways [131, 132, 144, 146, 151]. Divergent social and possibly gender-related norms for how to deal with loneliness and how alcohol is used in social settings across countries may explain some of the conflicting findings.

Mental distress

In contrast to other research, we found no association between either at-risk drinking or binge drinking and mental distress [139, 143, 144, 149, 163]. On the other hand, in accordance with other findings, we identified a relationship between alcohol-related problems and mental distress in both sexes [155, 178, 181]. There was also a strong link between mental distress and abstinence in women, but not in men. Some evidence suggests that greater perceived stress is associated with lower consumption among women but greater odds of problematic use in men, highlighting differences in the relationship between stress and alcohol use by gender [141, 164]. Coupled with our finding that poorer SRH is strongly associated with alcohol abstinence in women, but not in men, there appears to be gender differences in risky

health-related behaviours among older adults [17, 84, 239, 247]. Despite the fact that evidence suggests a causal linkage between elevated alcohol use and depression, such that increasing use of alcohol increases the risk of depression in the general adult population [248], this is not a consistent finding among older adults. Although many older adults report to use alcohol to relieve symptoms of depression, anxiety or pain [144, 247, 249], several studies have found a decreased burden of depression among older adults with risky drinking habits [132, 165, 250]. Still, the conflicting results regarding correlations between risk use and mental health indicate that more research is needed to increase knowledge about subgroups of older adults who might be more susceptible of adverse mental effects due to alcohol consumption.

5.2.3 High-level alcohol consumption and abstinence: significant sex differences in the association with SRH

Sub-study II & III found that high levels of alcohol consumption are associated with very good health in women, but not in men [239]. Among women, but not men, it has been shown that those who report heavy episodic drinking or daily drinking have better SRH, as compared to women who reported low-risk alcohol use, suggesting potentially health-confirming properties associated with alcohol use among women [156]. In fact, some evidence indicates that moderate alcohol intake may carry some health benefits for older women in terms of survival and quality of life, possibly mediated through a healthier drinking pattern than men and cardio-protective effects [191, 192, 251, 252]. Furthermore, sub-study II found that abstinence from alcohol was associated with poor SRH in women, but not in men. Being abstinent from alcohol or stopping drinking is associated with poorer SRH and declining health trajectories in older adults [110, 168, 253, 254]. The rates of poor SRH among non-drinkers are significantly higher than the rates of poor SRH for any levels of alcohol consumption. Our findings indicate that the “sick quitter effect” applies especially to older

women, thus, the majority older women appear to drink according to their health situation, while older men exceed at-risk drinking thresholds regardless of good or poor health. This is in line with other findings of gender differences regarding risky health behaviours, and might explain why possible health benefits are sex specific [17, 33, 34, 84, 140, 164, 178, 237]. On the other hand, some studies have found that having a very good health status is a predictor of alcohol consumption, and not the other way around i.e., frequent drinking and heavy episodic drinking in old age is an indicator rather than a cause of the health status, and this is especially the case in women [156, 168]. Nonetheless, the differing results regarding correlations between high-level consumption and SRH indicate that more research is needed to increase knowledge about subgroups of older adults who might be more susceptible of adverse health effects due to alcohol consumption

5.2.4 High-level alcohol consumption: Factors associated with mortality show possible cohort effects

Our finding of an equal risk of mortality when we compared older adults who drank more than 100 g / week with those who consumed less than 100 g / week over a 25 year follow-up period contrasts with the widely accepted J- or U-shaped association [108, 173, 193-195]. Although we did not find clear evidence of an independent negative effect on either mortality or SRH for exceeding 100 g / week compared with moderate drinking levels, there are several possible explanations that may explain the finding.

Firstly, the average weekly alcohol consumption, even in the high-level consumption group, was just above the suggested threshold in women and not very high in men. We decided not to divide average alcohol consumption into several groups, in order to investigate all the included covariates as moderators with enough power in each drinking group. As discussed in section 5.1.1, our main interest was to investigate *for whom* it may be more harmful to exceed

suggested drinking thresholds. We did not aim to identify a specific threshold at which alcohol consumption becomes harmful in older adults, as the heterogeneity is very large in this population, which spans almost two generations [69, 70]. Our goal was rather to investigate whether there is reason to warn so loudly about the dangers associated with increased drinking in a general population of older adults [8, 60, 102]. However, using average alcohol consumption as a continuous variable could have given us a better estimate of a harmful drinking threshold for the majority of older adults. Nevertheless, older adults in high-income western European countries, including Norway, appear to drink level-headedly, i.e., they drink frequently but consume relatively small amounts of alcohol on each occasion [4, 126, 238, 239]. It is therefore possible that negative health consequences are less common among Norwegian older adults, even at the highest level of average consumption, compared to younger adults and adolescents who usually drink heavier when they first drink [173, 192, 251, 255].

Secondly, as already described in section 1.2.4 and further discussed in section 5.1.1, there are no standardized measures or identical definitions for at-risk drinking thresholds in old adulthood across the world [101, 118]. Thus, the 100 g / week limit may not be a valid cut-off to identify those at risk for adverse consequences. Furthermore, due to the "preventive paradox", namely that light-to-moderate consumers are responsible for the majority of alcohol-related harm, simply because the large number of such drinkers make up for their smaller individual risk [256-258], it may be difficult to identify adverse health outcomes without stratifying according to special risk groups (e.g., according to polypharmacy, comorbidity, mental health problems, etc). Furthermore, since older adults are likely to be even more exposed to the harmful effects of low-to-moderate alcohol intake due to higher BAC of the same amount of alcohol as younger adults, the "preventive paradox" may apply even more to them as a group. The results might have been different if we had used other

statistical models, such as stratification by other risk factors, in addition to sex, and / or including other interactions terms.

Thirdly, in line with other findings from Norway, we found that the average SRH level improved during the study period, the proportion who had never smoked increased, the proportion with severe physical illness decreased, and the proportion with hypertension or hypercholesterolemia decreased [169, 186, 251]. These findings indicate a healthier elderly population which may have counteracted any adverse effects of increased alcohol consumption.

Fourthly, among the high-level drinkers, a higher proportion were highly educated, lean (women), had normal blood pressure (women), had less physical illness, and reported more hours of weekly physical activity. In 2017, life expectancy in Norway was 84.3 years for women and 80.9 years for men. The social inequalities in life expectancy are increasing, and are greater in Norway than in many other European countries, especially among women [169]. The findings of as low mortality risk for the high-level drinking group as among the moderate drinkers can therefore correspond to social inequalities in life expectancy and may not be due to high alcohol consumption per se. Socioeconomic status plays a key role in the presumed "heath benefits" of alcohol consumption for older adults, as health consequences of similar drinking patterns are more severe for those with lower socioeconomic status, known as the “alcohol harm paradox” [134-136]. Nevertheless, our findings suggest that a large proportion of older high-level drinkers’ balanced risk factors are beneficial, especially among those with higher socioeconomic status, which is in line with other findings [168, 249, 254].

Finally, but not least, we cannot rule out an emerging cohort effect of increased alcohol consumption in old adulthood. A large proportion of baby boomers do not consider medical health problems to be a constraining factor for alcohol consumption [49, 99, 146]. This may

increase the risk of adverse health effects of even low-to-moderate alcohol consumption in subpopulations of older adults, which may help to explain why we were unable to identify differences in mortality between the two drinking groups. A recent novel observational study, found that exceeding just 56 g / week was associated with poorer cognitive performance[259]. They suggest a potential biological link between moderate alcohol consumption and cognitive decline, mediated through iron accumulation in the brain. Furthermore, a survival bias may also explain that we did not identify increased mortality among the high-level drinkers, since those who experience health impairment reduce consumption [110, 168]. Table 8 shows the hazard ratios when comparing the baby boomers with the pre-world war II generation. Although not yielding significance, a trend towards increased mortality risk in women from the baby boom cohort that exceeds 100 g / week can be observed.

Table 8 *All-cause mortality risk by alcohol consumption according to cohort in Tromsø4-7*[a]

	Pre-War II generation (born before 1946)		**Baby Boomers (born after 1946)**	
	Women (OR)	Men (OR)	Women (HR)	Men (HR)
Abstinence	1.29*** [1.16, 1.44]	1.16** [1.04, 1.30]	2.37* [1.10, 5.13]	1.84 [0.82, 4.16]
≥ 100 g / week	0.96 [0.73, 1.26]	0.93 [0.80, 1.08]	1.17 [0.51, 2.69]	0.84 [0.45, 1.54]

[a]Detailed information from adjusted analyses is found in S.Table 2 in sub-study III.

The hypothesis of possible adverse health-related consequences due to an interaction with the drinking pattern (HED) could not be confirmed in our study. In contrast to other findings that binge drinking is particularly harmful in older adults [37, 96, 108, 109], our study did not find that frequent binge drinking was a significant confounder or moderator of either SRH or all-cause mortality. Some have reported similar findings, which may imply that binge drinking is an imprecise measure to identify the harmful use of alcohol [177, 260]. On the other hand, it has been argued that AUDIT-3 underestimates health-impacting HED in older women, since the criterion of 6+ drinks may be too high to identify harmful binge drinking in women [116].

It is possible that we could have identified binge drinking as a moderator of the adverse health consequences of average alcohol consumption if we had lowered the threshold for HED.

Being a non-drinker of alcohol was associated with both poorer SRH and greater mortality risk, in line with previous findings, but the findings have limitations due to a misclassification bias as described in section 5.1.1, i.e. the "sick quitter effect" [110, 191, 193, 198, 261]. We therefore decided early in the planning phase that abstainers should not be the reference group in the analysis.

5.2.5 Alcohol consumption: No need for specific thresholds for older age and according to sex?

Even if we found that alcohol consumption is very prevalent among older adults in Norway, and that almost half of current drinkers exceeded at-risk drinking thresholds among both women and men, this may not involve actual risky drinking [239]. Older people in Norway drink frequently, and reporting to drink alcohol four times a week gives an AUDIT-C score of 4, even if the usual quantity is only 1 or 2 units. Nevertheless, we identified a higher likelihood of experiencing some sort of alcohol problem among older women with the highest level of education in 2015-2016. This may indicate that the increase in the proportion of at-risk drinkers, especially among highly educated women, is beginning to show adverse effects, as suggested by Skog and recently claimed by Rossow et al [44, 50, 246]. This can also become an increased public health concern, as women live longer than men and may increasingly need health services and interventions due to alcohol-related problems [61, 124, 262]. In addition, the changes in alcohol habits might not have lasted long enough to show an independent effect on mortality risk. If one is to compare with other health-related risk factors, such as smoking, there is a strong correlation between pack-years (a measure for the accumulated amount a person has smoked, calculated by multiplying the number of packs of

cigarettes smoked per day by the number of years the person has smoked) and morbidity / mortality. Our study had no data on accumulated alcohol consumption throughout life. It is likely that those who have had heavy alcohol consumption earlier in life have accumulated more adverse health-related consequences than those who started consuming higher levels only in old age [110, 263].

The models in our study included repeated measures of alcohol consumption to capture the effect of changes in consumption level over time during follow-up. It is likely that those who experienced deterioration in their health situation stopped drinking and contributed in the "sick quitter effect" observed in the Kaplan-Meier plots. Thus, our study does not prove that a persistently high consumption level is associated with reduced mortality risk. Excessive alcohol consumption is harmful to both older and younger adults and increasing alcohol consumption among older adults gives cause for concern. Besides, it has been shown that SRH may improve in older adults as a result of stopping drinking [254].

6 Conclusions

We identified a considerable increase in alcohol consumption among older adults in Norway between 1994 and 2016, for both men and women. However, women have increased their consumption more than men, implying reduced gender differences in drinking behaviour. Despite the fact that most of the epidemic increase in alcohol consumption was among the privileged and healthy older adults, and this was especially true for women, increased drinking will also imply an increase in very heavy drinkers [44, 50, 246]. Increased at-risk use and alcohol problems in the growing population of older adults are therefore likely to present major challenges for the future health care system in terms of recognition, interventions, and determining the most appropriate treatment options [60].

Our findings suggest that risk individuals who may experience alcohol-related problems include older adults who live alone; who do not have enough social support; who are in poor health; who are mentally distressed; who are prescribed sleeping pills; and in fact, those with a very high level of education (in women). In addition, preventive case-finding strategies should address men who are prescribed sleeping pills or have smoked more than 20 years, and women with a high comorbidity burden or are over 75-80 years of age, as they have higher chances of experiencing health deterioration (SRH) in combination with alcohol.

We found no clear evidence of an independent negative effect on self-rated health trajectories or mortality of exceeding an average of 100 g / week compared to low-to-moderate drinking. However, interpreting our findings as evidence of a protective effect of high-level drinking on any health-related outcome while ignoring the dynamic relationship between poor health and drinking behaviour is probably not correct. Older

adults are likely to be more susceptible to harmful effects of alcohol at lower blood alcohol concentrations compared to younger adults, thus, the “preventive paradox” may apply even more to them as a group. The proportion of high-level drinkers was considerably lower than moderate drinkers, and because even low-to-moderate drinking older adults may be at high risk of adverse health effects, this may help explain why we were unable to identify a group difference. Our findings imply that a change in governmental strategies and alcohol policy to influence alcohol-related health behaviours in older adults should be considered.

7 Implications and future perspectives

There are several implications related to the findings from this thesis.

- The findings are consistent with Skog's theory, as the population of older adults appear to move in concert up the consumption scale [44]. According to the literature, political strategies to target population drinking (APC) are recommended, as they are likely the most efficient way to prevent regular drinkers from becoming very heavy drinkers [50, 246, 260, 264, 265]. However, a more efficient alcohol policy may necessitate more targeted interventions aimed at older adults. Moreover, prevention strategies towards both high-risk subgroups and APC are needed, since not all groups within a society change their alcohol consumption in concert [266, 267].
- It is important to raise public awareness of the substantial changes in alcohol habits among older adults. Many at-risk drinkers fit into the perception of "successful aging", with higher levels of education, better health and a larger degree of social satisfaction than low-risk drinkers, and this is especially true for women [30, 31, 33, 90, 112, 115, 124, 238, 239]. Our findings suggest that a subgroup of high-level drinkers who live alone, who use sleeping pills, who are in poor health and have the highest education (women) may experience alcohol-related problems.
- Our findings imply that it should be as relevant to ask about alcohol use as it has been to ask about smoking when older adults are admitted to hospitals, are visiting the doctor or receive home-based care. Health professionals can facilitate important interventions, such as health advice on increased risk of falls, accidents and confusion due to alcohol use, especially in combination with poor health or prescribed medication [56-58, 268]. Increasing the knowledge of the high prevalence of frequent drinking among older adults might reduce symptom misinterpretation and under-detection of alcohol misuse [155, 269].

- Our findings do not support the need for specific alcohol thresholds due to chronological age. However, general health advice to older adults about potentially harmful interactions between alcohol and commonly prescribed medications must be given at every opportunity, due to the high prevalence of frequent drinking [56, 57, 91]. Future research would benefit from developing standardized measures across the world and use identical definitions to make valid comparisons of alcohol consumption and health consequences [96, 101, 118].
- The health authorities should consider to label alcoholic beverages with the unit number per serving to promote the understanding of the content [95, 99-101]. Additionally, alcoholic beverages should contain information that sex differences and increasing age imply reduced "body water" resulting in higher BAC per unit to promote sensible use, similar to the information on nicotine and caffeine-containing products [20, 59-61, 65].
- Researchers should disseminate information to the general population of older adults about the potential health risks of elevated alcohol consumption, to counteract biased media reports [47, 48, 119, 270].
- New services and collaborations may need to be developed, due to the evidence of increased combined use of alcohol and psychoactive prescription medications, and high prevalence of comorbid mental and physical health conditions in older adults [59, 60, 63, 74, 263]. Due to the high incidence of medical and neurological complications during alcohol withdrawal in older compared to younger adults, specially trained geriatric health professionals should work in these locations [79, 181, 240].
- Future research should investigate the effects of exceeding suggested low-risk thresholds among more vulnerable older adults, such as those who have been

hospitalized, those receiving psychiatric treatment and those with polypharmacy, including those over 80 years of age [62, 89, 271].

- Future research should longitudinally investigate whether adverse health effects of high-level drinking increase in the baby boomers when the changed alcohol habits have lasted for a longer period [74, 119, 121, 240].
- Furthermore, genetic factors may affect the risk of elevated alcohol consumption, alcohol metabolism, alcohol-related health consequences and interactions between alcohol and prescribed medications [174, 272]. The evidence on alcohol consumption and health-related consequences in older adults is still insufficient, and future research should include genetic factors.

8 References

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Paper 1

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Substance Abuse Treatment, Prevention, and Policy

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The changing alcohol drinking patterns among older adults show that women are closing the gender gap in more frequent drinking: the Tromsø study, 1994–2016

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Abstract

Background: As the population of older adults continues to grow, changes in alcohol consumption are important to monitor because an increase may have public health consequences. Rates of alcohol use vary with geographical location. The aim of this study was to examine trends in alcohol consumption among older adults in a geographically defined area in Norway, especially changing sex differences in drinking patterns over a 22-year period.

Methods: Repeated cross-sectional survey (in 1994–95, 2007–08, and 2015–16) of a general population of older adults. Eligible for this study were 20,939 participants (aged 60–99 years). The data were analysed using generalized estimating equations, stratified by age and sex. Alcohol consumption and drinking patterns were assessed, using an adaptation of the AUDIT-C.

Results: Between 1994 and 2016, there has been a significant increase in the proportion of current drinkers among older adults. Furthermore, the probability of frequent drinking (alcohol consumption at least twice weekly) increased significantly between 1994 and 2016, particularly among older women; OR 8.02 (CI 5.97–10.79) and OR 5.87 (CI 4.00–8.63) in the age groups 60–69 and 70+ respectively for women, and OR 4.13 (CI 3.42–4.99) and OR 3.10 (CI 2.41–3.99), in the age groups 60–69 and 70+ respectively for men. The majority of older adults drank small amounts of alcohol on typical drinking days, but there was an increasing probability of drinking three drinks or more on each occasion over the study period, except among women aged 70+ years.

Conclusions: Among older adults in Norway, alcohol consumption in terms of frequency and quantity on typical drinking days has increased considerably from 1996 to 2016. This change is in the opposite direction of what has been reported among younger adults. The gap between women and men in frequent drinking has been markedly narrowed, which indicate that women's drinking patterns are approaching those of men. This may involve a need to change alcohol policy in Norway to more targeted interventions aimed at older people.

Keywords: Alcohol drinking patterns, Alcohol policy, Older adults, Sex differences, Public health, Tromsø study, Norway

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Changes in the prevalence of alcohol consumption among older adults may have important public health implications, as alcohol use is a leading risk factor for injuries, mortality and the burden of disease [1–3]. The number of people above the age of 65 is estimated to be doubled by 2050 [4], healthy life expectancy is increasing and the heterogeneity in health status among aging people is greater than in the past [5]. Older adults have a higher incidence of comorbid mental and physical health problems and a higher rate of polypharmacy, compared to younger adults [1, 6–8]. Due to a smaller proportion of body fluids and reduced liver function, which means reduced dose tolerance, older adults are more vulnerable to the physical, psychological and cognitive adverse effects of alcohol, compared to younger adults [9–11]. Older women are even more susceptible than older men, due to naturally lower levels of body water in women than in men, resulting in higher concentrations of alcohol in the blood after drinking equivalent amounts of alcohol [12].

Traditionally, alcohol use has been moderate in older compared to younger adults, and men have had more harmful drinking habits than women, including more frequent drinking and consumption of larger quantities on typical drinking days [13–16]. Recent studies report that older adults in both the Nordic and other European countries have increased their alcohol consumption over the last decades, with diminishing sex differences in drinking patterns [15, 17–21]. However, the size of the changes in alcohol consumption and the size of the changes in differences between the sexes (i.e., prevalence rates of men to women) vary across studies, depending on factors such as social class, ethnicity, and geographical settings [13, 17, 19, 22–24]. Moreover, the prevalence of potentially harmful drinking among older adults varies from 10 to 42%, or even more, as the criteria for "at-risk", "hazardous" or "unhealthy" drinking in older adults are currently inconsistent and vary between studies [25–28]. The US National Institute on Alcohol and Alcoholism (NIAAA) advises that people older than age 65 who are healthy and who do not take any medicines have no more than seven drinks a week, and no more than one drink on any 1 day, whereas The UK alcohol guidelines of 14 units a week may be to be too generous for older people [29]. Knowledge of the lower limits of potential harm from alcohol is constantly growing, but most countries in Europe, including Norway, lack specific guidelines addressed to older adults [14, 30]. Inconsistency in findings implies possible differences between countries in drinking patterns of older adults and that the importance of sex for drinking patterns might differ between countries. However, the European definitions of "one unit of alcohol" vary between 8 and 20 g of pure ethanol [2], which means that even well-defined guidelines can be interpreted very differently. Longitudinal surveys from different geographical locations are hence needed to investigate variations and monitor changes in alcohol use in different aging populations. In Norway, one unit of alcohol is defined as 12 g of ethanol.

The aim of the present study was to investigate trends in alcohol consumption among older adults (defined as those aged 60 years and over) in an urban municipality in Norway, by comparing participants in a population study from the same geographical setting across 22 years. We aimed to describe age- and sex-stratified changes in i) proportion of current drinkers ii) alcohol drinking pattern in terms of past year drinking frequency, and quantity on typical drinking days (≤2 units/≤24 g of ethanol, here defined as "moderate" or ≥ 3 units/≥36 g of ethanol, here defined as "at-risk"), and iii) heavy episodic drinking (HED) last year (≥6 units/≥72 g of ethanol in one occasion). In particular, we aimed to investigate whether sex differences in alcohol consumption among older adults have changed.

Methods

Study design and study sample

Our study design is a repeated cross-sectional examination of a large general population living in a geographically defined area in Norway. The data used in this study are taken from The Tromsø Study, an ongoing population-based cohort study conducted in the municipality of Tromsø, the seventh largest city in Norway. The study was initiated in 1974 and currently consists of seven surveys [31, 32]. A total of 45,473 persons have participated in at least one of the surveys. The present study is based on three of the Tromsø surveys, Tromsø 4 (1994–95), Tromsø 6 (2007–08) and Tromsø 7 (2015–16), in order to examine trends in drinking patterns over the last 22 years. Data were retrieved from participants aged 60 years and over at the time of participation and who answered questions about alcohol consumption. All residents of Tromsø municipality aged 60 years and over were invited to these three surveys, and it thus constituted a random sample. In 1994, the number of inhabitants in Tromsø was 54,600, and in 2016 it had increased to 73,480. Eligible for this study were 5861 participants (55% women) from Tromsø 4, 6462 participants (53% women) from Tromsø 6 and 8616 participants (52% women) from Tromsø 7 (Table 1).

Measures

Alcohol consumption

Alcohol consumption was measured with an adaptation of the AUDIT-C (Alcohol Use Disorders Identification Test-Consumption), which is an abbreviated version of the 10-item AUDIT [33], consisting of three items on the past years` frequency of drinking (never, monthly or

Table 1 Overall sample characteristics (≥60 years, $N = 20,939$)[a]

	Tromsø 4 (1994-95)	Tromsø 6 (2007-08)			Tromsø 7 (2015-16)		Total
Men	N (%)	Attendance (%)	N (%)	Attendance (%)	N (%)	Attendance (%)	N
Age groups							
60-69	1,479	87	1,995	74	2,502	71	5,976
70+	1,134	70	1,037	61	1,663	63	3,834
Total	2,613	78	3,032	69	4,165	68	9,810
Age, mean (SD)	69.1 (6.8)		67.8 (6.4)		68.8 (6.7)		
Education (%)							
Higher (>12 years)	360 (14)		980 (33)		1644 (41)		
Relationship status (%)							
Spouse or partner	1819 (82)		2441 (82)		3251 (81)		
Women	N (%)	Attendance (%)	N (%)	Attendance (%)	N (%)	Attendance (%)	N
Age groups							
60-69	1,620	90	2,107	80	2,677	75	6,404
70+	1,628	67	1,323	58	1,774	55	4,725
Total	3,248	76	3,430	70	4,451	65	11,129
Age, mean (SD)	70.5 (7.1)		68.6 (7.0)		68.9 (7.0)		
Education (%)							
Higher (>12 years)	210 (7)		711 (21)		1431 (33)		
Relationship status (%)							
Spouse or partner	1369 (57)		1958 (60)		2654 (65)		

[a]Number of participants (N) and attendance rates of the overall invited residents in Tromsø (%), stratified by age and sex in three surveys from the Tromsø Study

less, 2–4 times a month, 2–3 times a week, or 4 or more times a week), number of drinks on a typical drinking day (1–2, 3–4, 5–6, 7–9, or 10 or more), and frequency of heavy episodic drinking (HED), 6 units or more (≥72 g of ethanol) in one sitting (never, less than monthly, monthly, weekly, daily or almost daily). The AUDIT-C is recommended for identifying at-risk drinking prevalence in older adults [28]. We dichotomized drinking frequency to "infrequent" (< 2 times a week) or "frequent" (≥2–3 times per week) drinking, as this cut-off limit is used in other comparable studies [7, 34]. Due to some evidence on cut-off limits of at-risk drinking among older adults [26, 35, 36], we dichotomized drinking quantity to "moderate" (≤2 units/≤24 g of ethanol) or "at-risk" (≥3 units/≥36 g of ethanol) drinking on typical drinking days. HED was dichotomised to "never" or "ever", due to the fact that HED at least once yearly identifies those at risk of harm from any heavy drinking [28, 33].

The questionnaires on alcohol consumption differed slightly in Tromsø 4. Abstinence was measured by the question; "Are you a teetotaller" with response alternatives "yes" or "no". Frequency was measured by an open question: "During the last month, how often did you consume alcohol?". Quantity was measured by the question; "How many drinks of beer, wine and spirits do you consume during a usual two-week period?". The question about HED was the same in all three surveys, but was asked only to participants < 70 years in Tromsø 4. Supplementary Table 1, Additional file 1, gives a comprehensive description of the measurements of alcohol consumption in Tromsø 4 and how they were operationalized to be comparable to the measurements in Tromsø 6 and 7.

Sociodemographic variables

Age was measured as a continuous variable and subsequently recoded into two age groups: 60–69 years, and 70 years and older (70–99). Sex was coded 0 (females) and 1 (males). One questions about educational level was included. In Tromsø 4 and 6, there were five response categories; 1) 7–10 years primary/secondary school 2) Technical school, middle school, 1–2 years senior high school 3) High school diploma (3–4 years) 4) College/university, < 4 years, 5) College/university, ≥4 years. In Tromsø 7, there were four response categories; 1) Primary/partly secondary education (up to 10 years of schooling) 2) Upper secondary education (a minimum of 3 years) 3) Tertiary education, short (college/university, < 4 years) 4) Tertiary education, long (college/university, ≥4 years). We dichotomized educational level into 1)

Lower educational level (categories 1–3 in Tromsø 4 and 6, and categories 1–2 in Tromsø 7), and 2) Higher educational level (categories 4–5 in Tromsø 4 and 6, and categories 3–4 in Tromsø 7). One question about living situation was included: "Do you live with a spouse/partner?" with two response alternatives: "yes" or "no".

Statistics

Continuous variables are presented as the mean (SD) and categorical variables as counts (%). Prevalence rates, sex differences and changes in sex differences in abstaining, infrequent/frequent drinking, moderate/at-risk drinking, and any/none HED last year were calculated for the total sample and separately for the age groups 60–69 and 70+.

Since a number of the individuals in this study participated in two (Tromsø 4/Tromsø 6 = 1589; Tromsø 4/Tromsø 7 = 583; Tromsø 6/Tromsø 7 = 3975) or all three of the surveys (545), these observations are considered clustered or non-independent. To account for this dependency, we used generalized estimating equations (GEE) for fitting logistic regression models. We specified models, with a logit link function, the correlation structure was set to exchangeable, and we selected robust standard errors. Binary variables of abstainers/drinkers, infrequent/frequent drinkers, moderate/at-risk drinkers and any/not HED last year were compared across time. Time (1994–95, 2007–08 and 2015–16) was used as an independent variable. 1994–95 was set as reference category in all models, except for HED in age group 70+. The question about HED was asked only to participants aged < 70 years in 1994–95. 2007–08 was thus set as a reference category in the model of older adults 70+, to enable comparison of changes in prevalence and sex differences among participants over 70 years between 2007-08 and 2015–16 in this drinking category. In order to test for changing sex differences between surveys we included an interaction term between sex and survey.

To describe overall changes in drinking patterns in the population of older adults we used unadjusted models. However, age, educational level and relationship status may account for some of the sex differences and in alcohol consumption [17, 19, 23], so these variables were included in the models of change in sex differences. Furthermore, the change in education level and relationship status differed between the sexes during the study period, separate models were therefore estimated to compare the influence of these covariates. Participants reporting to be abstainers were only included in the category of overall drinking/abstaining, and excluded from analyses of other drinking patterns. The results are reported as odds ratios (OR) with 95% confidence intervals (95% CI).

Changes in educational level and relationship status across time among men and women were compared with Chi-square tests. Data were analysed using IBM SPSS (Statistical Package for the Social Sciences), version 26.

Results

Sample characteristics

Mean age of the included older adults was 69.9 (SD 7.0), 68.2 (SD 6.7), and 68.9 (SD 6.9) years in the three consecutive surveys ($N = 20{,}939$). The overall attendance rates among those aged 60 years and over decreased for each survey, from 77 to 69% and 66% in the latest survey. In 1994–95, 69% of participants lived with a partner, compared to 73% in 2015–16. The difference in relationship status was significant among women ($p < 0.001$) but not among men ($p = 0.421$). A proportion of 10% had completed college/university education in 1994–95, compared to 27% in 2007–08 and 37% in 2015–16. The difference in educational level was significant in both women and men ($p < 0.001$ for both sexes).

Trends in abstaining (full sample)

The overall prevalence rates of abstaining decreased significantly for each of the three surveys from 31% in 1994–95 to 17% in 2007–08 and 11% in 2015–16 ($p < 0.001$). The prevalence decreased significantly in both men and women and in all age groups during the study period (Table 2).

In the youngest age group (60–69 years), 95% of men and 91% of women reported being current drinkers in 2015–16, compared to 85 and 68% respectively in 1994–95. Results from crude data are shown in Additional Fig. 1, Additional file 2.

Trends in alcohol consumption, frequency (current drinkers)

The majority of both men and women reported alcohol consumption once a month or less or 2–4 times per month, in both women and men. However, the prevalence of infrequent drinking was considerably reduced during the study period in all age groups (Table 2). Correspondingly, the overall prevalence of frequent drinking (drinking at least twice weekly) increased significantly for each of the three surveys from 9% in 1994–95 to 25% in 2007–08 and 35% in 2015–16 ($p < 0.001$). The change in sex- and age-stratified prevalence is shown in Fig. 1.

The likelihood of reporting frequent drinking increased more among women compared to men across the study period (Fig. 2).

Trends in alcohol consumption, quantity (current drinkers)

Most participants reported their number of drinks on a typical drinking day to be 1–2 units of alcohol (Table 3).

Table 2 Prevalence[a] of abstaining and drinking patterns (frequency) and odds ratios (OR)[b] across time

Age at participation	Time[c]	Abstaining (full sample)		Infrequent drinking < 2 times per week (drinkers only)		Frequent drinking ≥2–3 times per week (drinkers only)	
		% (N)	OR (95% CI)	% (N)	OR (95% CI)	% (N)	OR (95% CI)
Women							
60–69	1	31.6 (511/1616)	1	94.8 (1048/1105)	1	5.2 (57/1105)	1
	2	15.5 (321/2076)	0.42 (0.36–0.50)	73.9 (1297/1755)	0.18 (0.13–0.24)	26.1 (458/1755)	5.62 (4.16–7.59)
	3	9.1 (241/2657)	0.25 (0.20–0.29)	65.7 (1587/2416)	0.13 (0.09–0.17)	34.3 (829/2416)	8.02 (5.97–10.79)
70+	1	48.2 (779/1616)	1	95.7 (801/837)	1	4.3 (36/837)	1
	2	35.2 (438/1243)	0.64 (0.54–0.76)	82.9 (667/805)	0.26 (0.18–0.39)	17.1 (138/805)	3.80 (2.55–5.66)
	3	23.0 (398/1734)	0.36 (0.31–0.43)	73.1 (976/1336)	0.17 (0.12–0.25)	26.9 (360/1336)	5.87 (4.00–8.63)
Men							
60–69	1	14.5 (214/1477)	1	85.8 (1084/1263)	1	14.2 (179/1263)	1
	2	6.4 (126/1974)	0.43 (0.34–0.56)	69.3 (1280/1848)	0.38 (0.31–0.46)	30.7 (568/1848)	2.62 (2.16–3.19)
	3	5.1 (127/2491)	0.35 (0.27–0.44)	58.6 (1385/2364)	0.24 (0.20–0.29)	41.4 (979/2364)	4.13 (3.42–4.99)
70+	1	25.0 (282/1129)	1	87.7 (743/847)	1	12.3 (104/847)	1
	2	18.8 (190/1008)	0.75 (0.59–0.95)	78.5 (642/818)	0.59 (0.45–0.78)	21.5 (176/818)	1.70 (1.29–2.25)
	3	10.8 (179/1644)	0.40 (0.32–0.50)	66.4 (974/1466)	0.32 (0.25–0.42)	33.6 (492/1466)	3.10 (2.41–3.99)

[a]All age group by sex prevalence rate changes were statistically significant between 1994 and 95 and 2015–16
[b]OR from Generalized Equations Models with 1994–95 as reference, stratified by age group and sex, adjusted by educational level and relationship status
[c]Time: 1 = Baseline, 1994–95, 2 = 2007–08, 3 = 2015–16

However, the prevalence of at-risk drinking (≥3 units/≥36 g of ethanol per occasion) on a typical drinking day increased significantly during the study period among women aged 60–69 years from 16 to 22%, and among men from 28 to 44% in the age groups 60–69 and from 17 to 24% among those 70+ years ($p < 0.001$ in all age groups). Men have increased at-risk drinking more than women during the study period, as can be seen in the negative change in sex differences between 1994 and 95 and 2015–16 (Table 4).

Trends in heavy episodic drinking (HED)

The overall prevalence of older adults aged 60 to 70 years reporting any HED during the last year was reduced from 54% in 1994–95 to 41% in 2007–08 and to 46% in 2015–16 ($p < 0.001$). The overall prevalence of older adults aged 70+

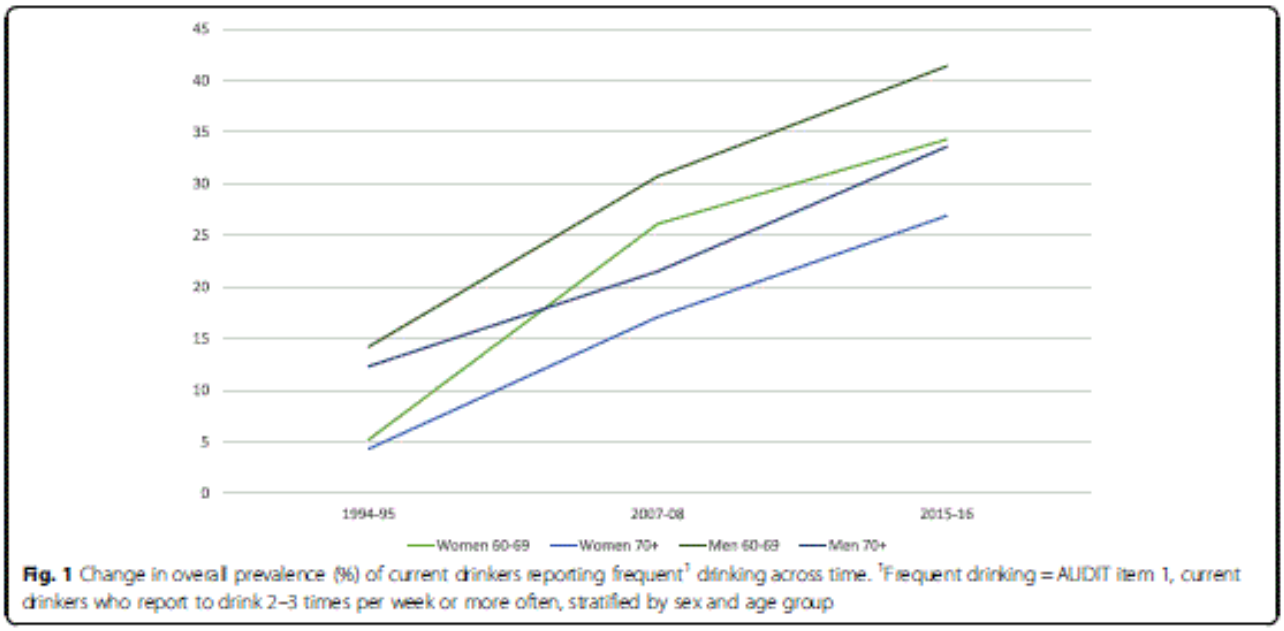

Fig. 1 Change in overall prevalence (%) of current drinkers reporting frequent[1] drinking across time. [1]Frequent drinking = AUDIT item 1, current drinkers who report to drink 2–3 times per week or more often, stratified by sex and age group

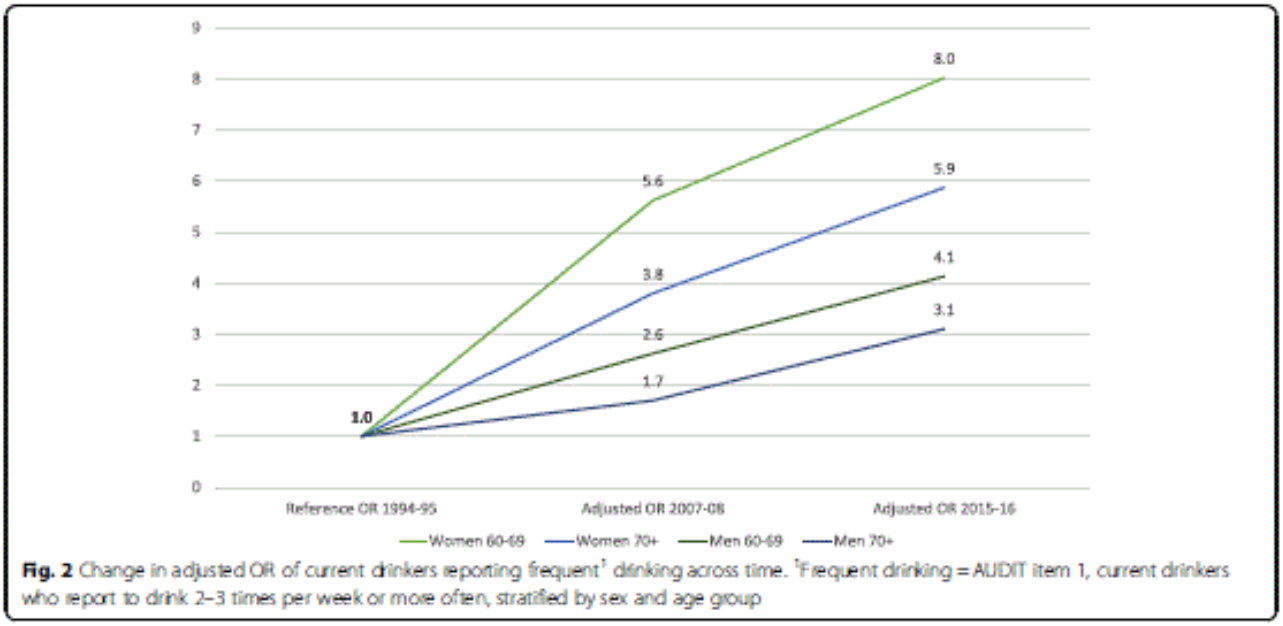

Fig. 2 Change in adjusted OR of current drinkers reporting frequent[1] drinking across time. [1]Frequent drinking = AUDIT item 1, current drinkers who report to drink 2–3 times per week or more often, stratified by sex and age group

years reporting any HED during the last year increased from 23% in 2007–08 to 26% in 2015–16 ($p = 0.020$). Men aged 60–69 years have increased any HED more than women in the same age group during the study period, as can be seen in the significant negative change in sex differences between 1994 and 95 and 2015–16 (Table 4). Although the models controlling for educational level and relationship status did not find significant differences compared to unadjusted models, a modest trend was observed towards a higher probability of reporting HED and at-risk drinking among those with higher educational level in the last survey (Table 5).

Table 3 Prevalence[a] of drinking patterns (quantity) and odds ratios (OR)[b] across time

Age at participation	Time[c]	Moderate drinking ≤2 units on typical drinking days (drinkers only)		At-risk drinking ≥3 units/≥36 g of ethanol on typical drinking days (drinkers only)		Heavy episodic drinking (HED)[d] (drinkers only)	
		% (N)	OR (95% CI)	% (N)	OR (95% CI)	% (N)	OR (95% CI)
Women							
60–69	1	84.0 (928/1105)	1	16.0 (177/928)	1	37.2 (295/793)	1
	2	84.2 (1448/1719)	1.02 (0.82–1.27)	15.8 (271/1719)	0.98 (0.79–1.22)	19.9 (342/1721)	0.43 (0.36–0.53)
	3	78.0 (1854/2377)	0.66 (0.54–0.81)	22.0 (523/2377)	1.51 (1.23–1.86)	26.9 (646/2400)	0.70 (0.59–0.84)
70+	1	91.6 (767/837)	1	8.4 (70/837)	1	–	
	2	94.6 (720/761)	1.84 (1.21–2.80)	5.4 (41/761)	0.54 (0.36–0.83)	11.6 (88/756)	1
	3	92.6 (1182/1277)	1.41 (0.98–2.04)	7.4 (95/1277)	0.71 (0.49–1.02)	15.1 (198/1315)	1.50 (1.32–1.71)
Men							
60–69	1	71.6 (904/1263)	1	28.4 (359/1263)	1	66.6 (749/1125)	1
	2	59.1 (1079/1826)	0.53 (0.45–0.62)	40.9 (747/1826)	1.90 (1.61–2.24)	60.4 (1103/1825)	0.91 (0.77–1.07)
	3	56.3 (1315/2337)	0.47 (0.40–0.55)	43.7 (1022/2337)	2.13 (1.81–2.50)	65.7 (1546/2352)	1.22 (1.04–1.43)
70+	1	83.0 (703/847)	1	17.0 (144/847)	1	–	
	2	80.3 (635/791)	0.83 (0.63–1.08)	19.7 (156/791)	1.21 (0.92–1.58)	33.9 (269/793)	1
	3	75.7 (1078/1424)	0.60 (0.47–0.76)	24.3 (346/1424)	1.68 (1.32–2.14)	42.3 (614/1453)	1.87 (1.55–2.25)

[a]All age group by sex prevalence rate changes were statistically significant between 1994 and 95 and 2015–16, except for at-risk drinking in women aged 70+ years
[b]OR from Generalized Equations Models with 1994–95 as reference, stratified by age group and sex, adjusted by educational level and relationship status
[c]Time: 1 = Baseline, 1994–95, 2 = 2007–08, 3 = 2015–16
[d]HED = any drinking ≥6 units/≥72 g of ethanol in one sitting last 12 months. Only participants aged < 70 years were included in 1994–95, thus 2007–08 was set as baseline in analysis of participants aged ≥70 years

Table 4 Prevalence rates, sex differences[a], and change in sex differences[b] in drinking patterns across time

Drinking pattern	Tromsø 4 (1994–95)			Tromsø 7 (2015–16)			Change in sex difference[b] 1994–95 versus 2015–16[c]	
	Women	Men	Multivariate adjusted sex differences OR (CI 95%)	Women	Men	Multivariate adjusted sex differences OR (CI 95%)	T4 versus T7	*P*
Abstaining								
60–69	31.6	14.5	0.38 (0.31–0.46)	9.1	5.1	0.56 (0.45–0.71)	0.18	=0.026
70+	48.2	25.5	0.37 (0.30–0.46)	23.0	10.8	0.43 (0.35–0.53)	0.06	=0.374
Frequent drinking, ≥2–3 times/week								
60–69	5.2	14.2	3.02 (2.22–4.12)	34.3	41.4	1.36 (1.21–1.53)	1.66	< 0.001
70+	4.3	12.3	3.06 (2.07–4.54)	26.9	33.6	1.36 (1.16–1.60)	1.70	< 0.001
At-risk drinking, (≥3 units/≥36 g of ethanol on typical drinking days)								
60–69	16.0	28.4	2.07 (1.69–2.54)	22.0	43.7	2.80 (2.47–3.18)	−0.73	< 0.001
70+	8.4	17.0	2.17 (1.59–2.95)	7.4	24.3	4.06 (3.18–5.17)	−1.89	< 0.001
Any HED (≥6 units/≥72 g of ethanol in one sitting) last year								
60–69	37.2	66.6	3.72 (3.03–4.57)	26.9	65.7	5.72 (5.03–6.51)	−2.00	< 0.001
70+	11.6	33.9	3.96 (2.97–5.28)	15.1	42.3	5.35 (4.35–6.57)	−1.76	=0.085

[a]Sex differences reported as odds ratios (OR), with 95% confidence intervals (CI 95%), adjusted for age, level of education and relationship status with women as references

[b]Change in sex difference: positive change indicates convergence (i.e. differences growing narrower), negative change indicates divergence. P-value for interaction term between sex and survey with 1994–95 as reference

[c]Only participants aged < 70 years were included in 1994–95, thus 2007–08 was set as baseline in analysis of participants aged ≥70 years

Discussion

Changing drinking patterns

We identified a significant increase in the proportion of current drinkers among older adults in Norway between 1994 and 2016. Infrequent drinking is markedly reduced, and more among women than among men. Correspondingly, we found a significant increase in frequent drinking among current drinkers, larger among women than among men. The proportion who reported an increased quantity of alcohol consumed on typical drinking days increased during the study period. Any HED during the last year was modestly reduced in those aged 60–69 years, whereas a modest increase in the prevalence of any HED was found in those aged 70 years and over. Any HED last year and at-risk drinking on typical drinking days remained the alcohol measures with the largest discrepancy between men and women.

Our finding of only 7% men and 15% women reporting abstinence in 2015–16 is in contrast to the findings by Nuevo et al. (2015) from 14 European countries, where an average of 55% abstainers was found among older adults over 60 years [13], the same prevalence as reported among US older adults [37]. It is, however, in line with epidemiologic studies from Norway and other Nordic countries with an observed prevalence of abstinence between 7 and 23%, depending on age group and sex [18, 38–40].

The total prevalence of 27% among female and 36% among male older adults who reported frequent drinking in 2015–16 is considerably higher than the prevalence of 14–16% among younger adults (aged 15–59) who report frequent drinking in Norway [38]. The increase in frequent drinking was also more extensive among women during the study period, which indicate that women's drinking patterns are approaching those of men. This is well in line with other epidemiological findings across Europe [14, 15, 20, 41], but the sex differences we found in frequent drinking in the latest survey are considerably smaller than observed in other European countries [13, 17, 21]. The findings are in accordance with recent population surveys from the Nordic countries [18, 34, 38, 40]. General societal changes over the last decades, such as an increase in women's rights, increased work participation for women and improvement of socioeconomic status relative to men's, may partly explain the reduced sex differences in frequent drinking [17, 19].

The prevalence of frequent drinking in the latest survey is higher than reported in several other studies [7, 13, 14, 34]. All participants in our study live in a medium sized Norwegian city, whereas other studies have included older adults from both rural and urban areas. People living in urban areas drink more than those in rural areas [38], which can partly explain our findings. Although higher educational level has been found to be associated with more frequent drinking [13, 15], our models that adjusted for this covariate did not significantly change the probability of reporting frequent drinking. Our finding of more frequent drinking among older adults stands in contrast to the observed decrease in total alcohol consumption in Norway since 2008 [16,

Table 5 Three models of the probability of reporting drinking patterns across time[a]

	Tromsø 6 (2007–08)			Tromsø 7 (2015–16)		
	Unadjusted OR (95% CI)	Model 1[b] OR (95% CI)	Model 2[c] OR (95% CI)	Unadjusted OR (95% CI)	Model 1[b] OR (95% CI)	Model 2[c] OR (95% CI)
Women ≥ 60 years						
Abstaining[d]	0.45 (0.40–0.50)	0.50 (0.44–0.60)	0.53 (0.46–0.60)	0.26 (0.23–0.29)	0.27 (0.25–0.31)	0.29 (0.25–0.33)
Infrequent drinking[e]	0.12 (0.10–0.15)	0.18 (0.15–0.23)	0.21 (0.16–0.26)	0.08 (0.06–0.10)	0.12 (0.09–0.15)	0.14 (0.11–0.18)
Frequent drinking[f]	5.93 (4.72–7.46)	5.48 (4.35–6.90)	4.81 (3.79–6.12)	9.06 (7.28–11.29)	8.49 (6.78–10.62)	7.19 (5.69–9.10)
Moderate drinking[g]	1.01 (0.84–1.20)	0.98 (0.82–1.17)	1.10 (0.91–1.33)	0.72 (0.62–0.85)	0.68 (0.58–0.81)	0.78 (0.66–0.93)
At-risk drinking[h]	0.99 (0.83–1.19)	0.88 (0.73–1.05)	0.81 (0.67–0.98)	1.38 (1.18–1.62)	1.41 (1.19–1.67)	1.29 (1.08–1.55)
Any HED last year[i]	0.42 (0.35–0.51)	0.44 (0.37–0.53)	0.43 (0.36–0.53)	0.62 (0.52–0.74)	0.68 (0.57–0.81)	0.68 (0.57–0.81)
Men ≥ 60 years						
Abstaining[d]	0.51 (0.44–0.60)	0.53 (0.45–0.63)	0.59 (0.49–0.70)	0.35 (0.30–0.41)	0.33 (0.28–0.39)	0.36 (0.31–0.43)
Infrequent drinking[e]	0.41 (0.36–0.48)	0.43 (0.37–0.50)	0.45 (0.39–0.53)	0.26 (0.23–0.30)	0.27 (0.23–0.31)	0.27 (0.23–0.31)
Frequent drinking[f]	2.43 (2.10–2.81)	2.31 (1.99–2.69)	2.22 (1.90–2.60)	3.87 (3.37–4.44)	3.88 (3.35–4.49)	3.73 (3.20–4.34)
Moderate drinking[g]	0.60 (0.53–0.69)	0.56 (0.49–0.64)	0.59 (0.51–0.67)	0.57 (0.51–0.64)	0.51 (0.45–0.58)	0.53 (0.47–0.61)
At-risk drinking[h]	1.66 (1.46–1.88)	1.66 (1.45–1.90)	1.62 (1.41–1.87)	1.75 (1.55–1.97)	2.07 (1.82–2.36)	2.03 (1.77–2.32)
Any HED last year[i]	0.77 (0.66–0.90)	0.82 (0.70–0.96)	0.83 (0.71–0.97)	0.96 (0.83–1.12)	1.22 (1.04–1.42)	1.23 (1.05–1.44)

[a]Odds ratios (OR) with 95% confidence intervals (CI 95%), from Generalized Equations Models with 1994–95 as reference, stratified by sex
[b]Adjusted for age and educational level (low/ high)
[c]Adjusted for age, educational level (low/ high) and relationship status (living alone/with a partner)
[d]Teetotaller or not drinking alcohol last 12 months; [e]< 2 times/week; [f]≥ 2–3 times/week; [g]≤ 2 units on typical drinking days; [h]≥ 3 units/≥36 g of ethanol on typical drinking days; [i]≥ 6 units/≥72 g of ethanol in one sitting

38], suggesting a shift in alcohol consumption from younger to older regular drinkers.

Some studies have found that the more often people drink, the more often they drink to intoxication [42, 43], and there is a strong and consistent correlation between mean consumption in a population and the proportion of at-risk drinkers [44]. This could partly explain our parallel findings of more frequent drinking and drinking larger quantities. Our study reports an increase in at-risk drinking in both women and men aged 60–69 years, and in men aged 70 years and older. This is in contrast to other recent findings from Nordic countries, where this drinking behaviour was found to be relatively stable since 2000 [38, 40]. Gell et al. found large variations in excessive drinking among older adults both between and within countries, in a comparative study of drinking patterns across developed countries, including Europe, the US and Australia; from 4 to 36% (defined as ≥2 units among women and ≥ 3 units among men) [15].

Binging is considered to be most harmful in old age [28, 37], and our study shows that 46% of participants between 60 and 70 years reported HED on at least one occasion last year. This prevalence of HED was larger than observed in other European countries [5, 14, 45]. Several of the studies on alcohol consumption in older adults and findings reported in systematic reviews are, however, based on older data. A more recent study from New Zealand found that 58% of men and 20% of women among community dwelling older adults aged 55–70 years reported HED at least once yearly using the AUDIT-C, which is in line with our findings [28]. Another recent study from Norway reported an increase in any HED, from 17% in 1985 to 30% in 2016–17 [38]. A comparative study from the Nordic countries, also reported increased prevalence of HED among older adults since 2000 [40]. At-risk drinking (≥3 units/≥36 g of ethanol) on typical drinking days and any HED (≥6 units/≥72 g of ethanol in one sitting) last year remained the alcohol measures with the largest discrepancies between men and women across the study period. Biological factors, including greater sensitivity to adverse health effects due to binge drinking among women, may explain part of the sex differences observed in these alcohol measures [11, 14].

Alcohol policy and societal changes

The primary objective of Norwegian alcohol policy has been to minimize alcohol-related health and social problems at the population level [44]. During the twentieth century, Norway has probably had one of the most restrictive alcohol policies in Europe with high prices and restricted availability, and in 2000 the level of alcohol consumption in Norway was one of the lowest in Europe [46]. The key features of current older adults in Norway, as in many other Western countries, are a higher educational level compared to previous generations, higher income, changing gender roles and a stronger focus on individualism, self-realisation and pleasure [47–49].

Changing alcohol habits have been suggested to represent a cohort effect from the "baby boomers" (those born between 1946 and 1964), who had higher exposure to alcohol in their youth and tended to be more tolerant about substance use than earlier generations [5]. More liberal attitudes towards alcohol among elderly people in Europe have been reported [14, 47, 49], as well as scepticism about the health risks of alcohol and even the view that not drinking alcohol could be negative for health [11, 47, 50]. The first generation of the baby boomers turned 65 years in 2011, hence, not all changes observed in the present study can be explained by such a cohort effect. It has also been suggested that drinking habits are "contagious" [44, 51], suggesting that increased alcohol consumption among younger cohorts of older adults may affect drinking habits in older cohorts. Furthermore, Norwegian senior citizens have greater financial security, better health and welfare schemes, less social inequality and more gender equality than in many other European countries [49]. These characteristics of societal and cultural differences may help explain the changing drinking patterns among older adults in Norway.

Importantly, the supply of cheaper alcoholic beverages through cross-border and international tax-free shopping has increased in recent decades, as has the number of alcohol outlets in Norway, and the sales of 3 litre wine cartons have become mainstream [16]. Previous findings of European levels of daily drinking have shown a north-south gradient with relatively higher consumption of wine in Southern Europe compared to Northern Europe, but fewer monthly binge drinking sessions [14]. Over the last two decades, total alcohol consumption in Norway has changed with increased wine sales and decreased beer and spirits sales [16]. It has been suggested that the drinking culture from Mediterranean countries, where many Norwegians take their vacations and where many seniors have "second homes", may have been adopted [16, 18]. However, our findings of both increased frequent drinking, in combination with preserved habits of bingeing, suggest the emergence of new drinking patterns among the Norwegian older adults with a possible combination of northern European and southern European drinking traditions.

Our findings support and extend accumulating evidence that sex differences in frequent alcohol consumption are decreasing [15, 17, 18, 20, 21], even in the oldest age groups, possibly suggesting shifting social norms surrounding gender and alcohol consumption. Holmila and Raitasalo (2005) have proposed social mechanisms mediating changes in women's drinking, including the stress caused by women's dual roles, the mimicking of male drinking patterns, changes in male-female drinking companionship, and changes in alcohol's position as a symbol of gender roles [22].

Clinical implications

The findings of this study may be particularly important for general practitioners and other health professionals. Important interventions, such as health advice on the increased risk of falls, accidents and confusion due to alcohol use, may not be reaching older adults as a result of symptom misinterpretation and a lack of key skills among health professionals in identifying and managing risky alcohol use in elderly people [10, 11]. Raising public awareness of the substantial changes in alcohol habits among older adults is therefore important.

Main strengths and limitations

The primary strengths of the population based Tromsø Study are the high number of participants from the same geographical area, the repeated survey design and the high rates of attendance, ensuring a high degree of representation. However, the proportion of participants in the oldest age group in our study was relatively low and may therefore be less representative of the general population. Since there has been few studies conducted including the oldest age group (70 years and older), our findings may nevertheless contribute to the evidence on alcohol consumption among older adults.

The Tromsø Study is based on self-reporting questionnaires, and because adults tend to underestimate their own alcohol consumption [52], there may be an underestimation of the alcohol consumption level. Furthermore, older people are even more likely to underreport alcohol use [53–55]. However, more liberal attitudes towards alcohol use in old age, including among older women, may have reduced stigma and shame in the last survey, and this may have contributed to less underreporting. In addition, variation in how questions were asked in the three surveys makes it necessary to exercise caution when interpreting the comparison across time. Open-ended questions about frequency and volume (as in Tromsø 4), without categorical response options (as in Tromsø 6 and Tromsø 7), may have increased the tendency to underestimate self-reported alcohol consumption. However, the significant findings on prevalence and sex differences in the two last surveys are based on identical questions.

As in general population surveys elsewhere [56], the participation rate in the Tromsø Study has declined [31], especially among participants aged 70 years and older. Alcohol misuse, abstaining from alcohol, and mental distress are moderately associated with non-participation in population surveys [57, 58]. However, in a comparable study from another county in Norway, this association weakened when controlling for other variables [56]. Nevertheless, the underrepresentation of people with high alcohol consumption, abstainers and people with

poor mental health should be taken into consideration when interpreting results from population-based health surveys.

As the Tromsø Study is based in the seventh largest Norwegian city with relatively few immigrants, it is limited with regard to ethnic diversity. The generalizability of results may therefore be limited to Caucasian populations that are similar to older adults of Norwegian descent. Furthermore, since the sample does not include rural living older adults the generalizability in prevalence rates of alcohol consumption may be restricted to urban living older adults.

Conclusions

Among older adults in Norway, alcohol consumption has increased considerably from 1996 to 2016. Compared to previous generations, the new generation of older adults drinks more frequently and consumes larger quantities on typical drinking days, while the prevalence of heavy episode drinking remains stable. The gap between women and men in frequent drinking has been markedly narrowed, suggesting that women's drinking patterns are approaching those of men. Even though overall drinking has increased, the changes are not necessarily connected to alcohol-related harm per se. Women and older adults are, however, particularly susceptible to the harmful effects of alcohol, which may imply that a change in governmental strategies and alcohol policy to influence alcohol-related health behaviours to more targeted interventions for elderly people is needed.

Abbreviations

AUDIT-C: Alcohol Use Disorders Identification Test-Consumption; CI: Confidence interval; GEE: Generalized estimating eqs; HED: Heavy episodic drinking. Drinking ≥6 units of alcohol/≥72 g of ethanol in one sitting last 12 months; OR: Odds ratio

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13011-021-00376-9.

Additional file 1: Figure S1. Alcohol consumption during the last year in three surveys from the Tromsø Study[1] (Additional file 2, .pptx) [1] Tromsø 4 = 1994–95, Tromsø 6 = 2007–08, and Tromsø 7 = 2015–16. From crude data.

Additional file 2: Table S1. Classification of alcohol outcome measures in Tromsø 4, Tromsø 6, and Tromsø 7.

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Authors' contributions

OKG and LTS conceived and designed the research. LTS acquired the data and performed statistical analysis. OKG, AH, RW and LTS handled funding and supervision. LTS drafted the initial manuscript. OKG, JGB, AH, RW, L-HL, and GS made critical revisions of the manuscript for key intellectual content. All authors read and approved the final manuscript.

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Availability of data and materials

The data that support the findings of this study are available from (http://tromsoundersokelsen.uit.no/tromso/) but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Research groups may apply for access to the data (see instructions on the website).

Declarations

Consent to publication

Not applicable.

Ethics approval and consent to participate

All participants provided written consent to the scientific use of their health survey data. The Tromsø Study has a license from the Norwegian Data Inspectorate and has been approved by the Regional Committee for Medical and Health Research Ethics (REC North). The present study is part of a research project approved by the REC North (case reference 2020/96868). Our study was performed in compliance with the Declaration of Helsinki.

Competing interests

Geir Selbæk has received honoraria for participating in one meeting of the Norwegian advisory board for Biogen, regarding the aducanumab trials. The other authors declare that they have no competing interests.

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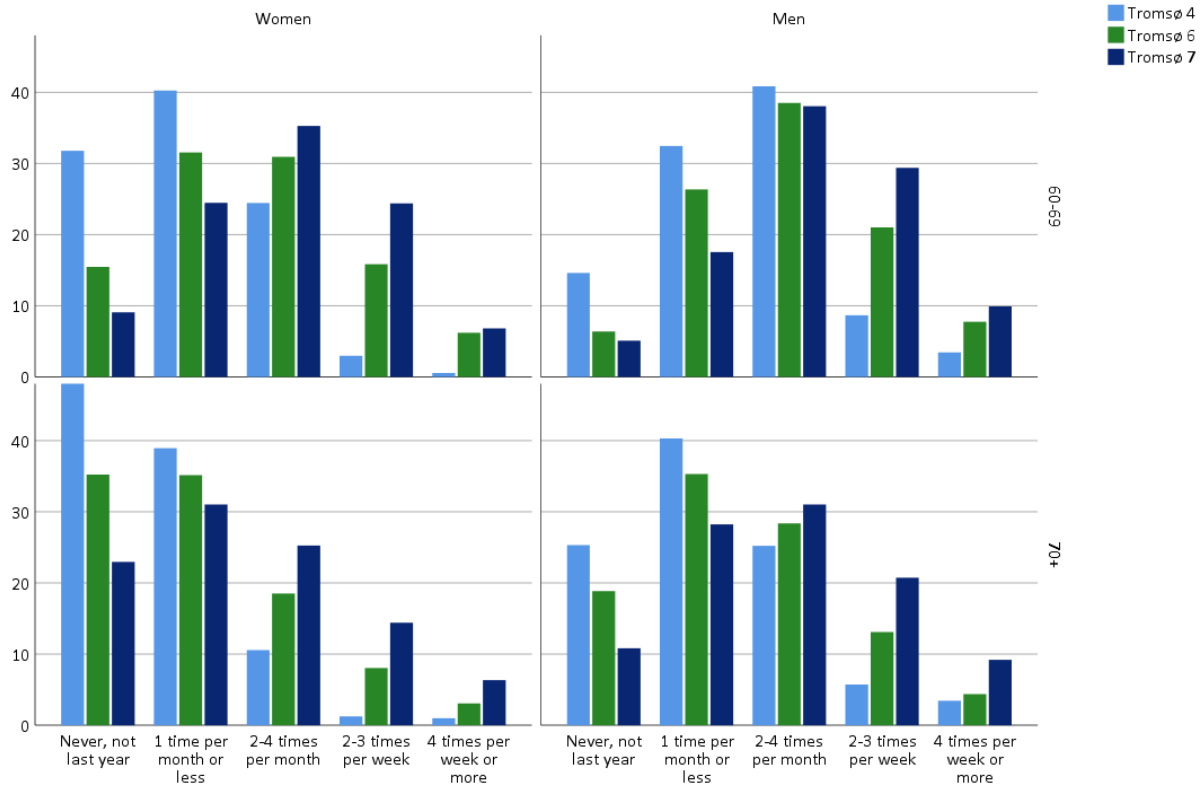
Publisher's Note

Appendix Figure 7 *Alcohol consumption during the last year in Tromsø4, 6 & 7*



Tromsø 4 = 1994–95, Tromsø 6 = 2007–08, and Tromsø 7 = 2015–16. From crude data

Paper 2

BMC Geriatrics

RESEARCH Open Access

Sex differences in at-risk drinking and associated factors–a cross-sectional study of 8,616 community-dwelling adults 60 years and older: the Tromsø study, 2015-16

Line Tegner Stelander[1,2*], Anne Høye[1,2], Jørgen G. Bramness[2,3], Rolf Wynn[1,2] and Ole Kristian Grønli[1,2]

Abstract

Background: Alcohol consumption among older adults is on the rise, which may be an increasing public health concern. The proportion of older adults who drink above defined low-risk drinking limits, associated characteristics and the sex distribution of at-risk drinking vary across countries. The aims of this study were to (i) estimate the prevalence of at-risk drinking among older adults in Norway, (ii) investigate factors associated with at-risk drinking, and (iii) examine sex differences in alcohol consumption in the context of sociodemographic and selected health characteristics.

Method: A cross-sectional study based on Tromsø 7 (2015–16), an ongoing population-based cohort survey. Data were retrieved from participants aged 60 and older (60-99 years) who answered questions about alcohol consumption ($n = 8,616$). Sex-stratified logistic regressions were used to assess the association between three at-risk drinking outcome variables, and sociodemographic and selected health characteristics. The outcome variables were operationalized using the Alcohol Use Disorders Identification Test (AUDIT), and Alcohol Consumption Questions (AUDIT-C), i.e. – cut off for at risk drinking, drinking any 6+ in the past year, and any alcohol problems.

Results: The overall prevalence of at-risk drinking among those aged 60-99 years was equal in women and men; 44% and 46%, respectively. At-risk drinking was strongly associated with a higher level of education, with OR 2.65 (CI 2.28-3.10) in women and OR 1.73 (CI 1.48-2.04) in men.

Conclusions: Almost half of older adults in Norway exceeded sex- and older adult-specific at-risk drinking thresholds. Our findings suggest some differences in factors associated with at-risk drinking between women and men. Explicitly, at-risk drinking was associated with very good health, living with a spouse or partner, and having adequate social support in women, while it was associated with the use of sleeping pills in men. Our findings suggest that women exceed at-risk drinking thresholds with better health, while men exceed at-risk drinking thresholds regardless of good or poor health.

Keywords: Alcohol consumption, At-risk drinking thresholds, Older adults, Elderly, Sex differences, Self-reported health status, Mental distress, Public health, Tromsø Study, Norway

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Background

Alcohol use among older adults may be a public health concern, as evidence of increasing alcohol consumption among older adults is growing [1–6]. Alcohol use represents a major cause of injury and mortality and is causally linked to a high number of diseases that are common in older adults [7]. As aging occurs, lean body mass and total body water decrease, and thus the same level of alcohol intake results in higher levels of blood alcohol content in older adults than in younger adults [4]. Furthermore, the liver's capacity to metabolize alcohol may be reduced, and biological changes to other internal organs and the brain (e.g., neuronal receptor sensitivity increase) can result in increased susceptibility to the harmful effects of alcohol [4, 8]. Older adults have higher rates of comorbidity and prescribed and over-the-counter drug use, and these factors may contribute to higher vulnerability to the detrimental effects of alcohol compared to younger adults [9].

In Europe, in 2016, the total alcohol per capita consumption among drinkers was 9.8 L, but 40% of the population (15+ years) had abstained from alcohol in the past 12-months [10]. In Norway, the total alcohol per capita consumption among drinkers was 9.4 L, and 21% had abstained from alcohol in the last year. Among adults aged 60 and older, the proportion who reported drinking alcohol at least twice weekly increased from 9-11% in 1994-95 to 25-35% in 2015-16, whereas the proportion among those aged 16-59 increased from 12 to 16%, which indicates a shift from younger to older regular drinkers of alcohol in Norway [11, 12]. There is growing evidence that "baby boomers" (those born between 1946 and 1964) are bringing their riskier drinking habits into old age [3, 5]. However, about one-third of older adults who develop drinking problems did not have drinking problems earlier in life, which may lead to this not being suspected as a problem by the physician [3]. Detection of harmful alcohol use in older adults can also be difficult, due to an atypical presentation (such as falls, incontinence, confusion, sleep problems, reduced or increased pharmacological effect of chronic therapies), or because it is masked by comorbid physical or psychiatric illness. [13].

Excessive drinking in later life, as opposed to low-risk drinking, has been associated with male sex, being closer to middle age, less than college education, poor physical health status, polypharmacy, cognitive impairment, poor mental health, loneliness, living alone (among men), size of social network, and social isolation [8, 14]. However, the factors listed here are based on studies performed in the US, since there is still a shortage of studies on alcohol use and associated characteristics among the current generation of older people in Europe [15].

The definition of "at-risk" drinking among older adults varies between studies [5, 16, 17]. The US National Institute on Alcohol and Alcoholism (NIAAA) advises that adults limit alcohol intake to 2 drinks or less in a day for men and 1 drink or less in a day for women, and those who take certain over-the-counter or prescription medications or have certain medical conditions should avoid alcohol completely [18]. However, there are currently no commonly accepted thresholds for at-risk drinking in older adults, and the use of different screening tools and populations ranging from community dwelling to psychiatric inpatients in the studies, has contributed to differing prevalence estimates of at-risk drinking, from approximately 10% in the US to 45% in New Zealand and the North European countries [2, 19–21]. There are several screening tools for at-risk alcohol use that have been validated in older adults [22]. One of these instruments, the Alcohol Use Disorders Identification Test (AUDIT), was developed by the World Health Organization as a method of screening for excessive drinking [23]. Both the full 10-item AUDIT, and the shorter three-item AUDIT-C, have been used in a variety of settings, including among community dwelling older adults, and have been shown to have a good ability to correctly identify those with unhealthy drinking habits [22].

Although some previous studies have investigated risky drinking patterns in older adults [14, 17, 19–21, 24–26], differentiated knowledge from various cultural settings is needed to identify the prevalence and predictive factors for at-risk drinking in this fast-growing segment of the population [27]. Furthermore, there is little research on sex differences related to the characteristics of at-risk alcohol consumers in the current generation of older adults. Filling this knowledge gap is important, to reduce the under detection and misdiagnosing of the health-related consequences of excessive alcohol use. The aims of this study were to (i) estimate the prevalence of three outcomes of at-risk drinking among older adults (defined as those aged 60 and older) in Norway, (i.e. AUDIT-C threshold of ≥3 for women and ≥4 for men, drinking any 6+ in the past year, and reporting any alcohol problems), (ii) investigate factors associated with at-risk drinking, and (iii) examine sex differences in alcohol consumption in the context of sociodemographic and selected health characteristics.

Materials and methods

Study design and study sample

This study is a cross-sectional examination of data from the Tromsø Study, an ongoing population-based cohort study conducted in the municipality of Tromsø, the seventh-largest city in Norway [28]. The present study is based on Tromsø 7 (2015–16) and is conducted to investigate factors associated with alcohol consumption in the current generation of older adults. Data were retrieved from participants aged 60 and older at the time

of participation who answered questions about alcohol consumption. All residents of Tromsø municipality aged 40 and older were invited to participate in the survey. Eligible for this study were 8,616 out of 12,973 invited participants aged 60 to 99 years at the time of participation, which represented a participation rate of 66% (Table 1).

Study variables

Social and demographic variables. Sex was stratified as women and men. Age was measured as a continuous variable and subsequently recoded into three age groups: 60–69 years, 70–79 years and 80 years and older (80-99). Educational level was categorized as (1) primary/elementary school, (2) secondary/upper secondary education (up to an additional three years) and (3) college/university/tertiary education (at least four additional years). Relationship status was assessed by the following question: "Do you live with a spouse/partner?" with the response alternatives: Yes or No. Social support/loneliness was measured by the following question: "Do you have enough friends you can talk confidentially with?" with the response alternatives: Yes or No.

Table 1 Sample description: Participants ≥60 years (n = 8,616) in the Tromsø survey (2015-16)

Characteristics	Number	Valid percentage
Total (attendance, %)	8,616 (66.4)	100
Sex		
Female (attendance, %)	4,451 (65.4)	51.7
Male (attendance, %)	4,165 (67.6)	48.3
Age		
60-69	5,179	60.1
70–79	2,676	31.1
≥80	761	8.8
Education		
Elementary school (up to 10 years)	3,054	36.6
High school (up to an additional three years)	2,207	26.5
College/university (at least four additional years)	3,075	36.9
Missing	280	
Relationship status		
Living with a spouse/partner	5,905	72.9
Living alone	2,199	27.1
Missing	512	
Enough social support		
Yes	7,197	86.4
No	1,132	13.6
Missing	287	
Self-reported health status		
Excellent	885	10.4
Good	4,497	52.9
Neither good nor bad	2,652	31.2
Bad or very bad	468	5.5
Missing	114	
HSCL-10 (cut-off 1.85)		
Yes	456	5.7
No	7,481	94.3
Missing	679	
Have used sleeping pills during last four weeks		
Yes	1,034	13.0
No	6,950	87.0
Missing	632	

Health characteristics. Self-reported health (SRH) is a subjective measure of the current state of health. SRH has been widely used in population surveys and is a well-known predictor of future health outcomes, use of health services and mortality in adults over 60 years, and is often used as a replacement instrument of comorbidities [29–31]. It was measured by the following question: "How do you in general consider your own health to be?" Response alternatives were categorized as (1) bad or very bad, (2) neither good nor bad, (3) good, and (4) excellent. Mental health was assessed using The Hopkins Symptom Check List-10 (HSCL-10), an abbreviated version of the original HSCL-90 [32]. This ten-item questionnaire is a widely used, self-administered instrument designed to measure mental distress (symptoms of depression and anxiety) in population surveys [33]. The suggested cut-off limit of HSCL-10 ≥1.85 [34] was used to dichotomize mental distress: Yes or No. One question about the use of sleeping pills during the last four weeks was included (not used, less frequently than every week, every week, but not daily, or daily), as the combination of z-hypnotics and alcohol consumption has been found to be high among older adults in Norway [35]. Response alternatives were dichotomized: Have used/Have not used sleeping pills during the last four weeks.

Alcohol consumption was measured by extracting the first three items of the 10-item Alcohol Use Disorders Identification Test (AUDIT) [23], often labelled AUDIT-C ("C" for consumption). AUDIT-C consists of questions on the frequency of drinking (0=never, 1=monthly or less, 2=2-4 times a month, 3=2-3 times a week, or 4=4 or more times a week), number of units on a typical drinking day (0=1-2, 1=3-4, 2=5-6, 3=7-9, or 4=10 or more), and frequency of heavy episodic drinking (HED) defined as ≥6 units (0=never, 1=less than monthly, 2=monthly, 3=weekly, 4=daily or almost daily). In Norway, one unit of alcohol is defined as 12 g of ethanol.

We used a threshold specific to older age to define at-risk drinking, suggested by Towers et al. [19], with a sex-specific AUDIT-C threshold of ≥3 for women and ≥4 for men. The third AUDIT-C item, often referred to as

AUDIT-3, is recommended as an independent screen of risky alcohol use in primary health care by the NIAAA. We used an AUDIT-3 threshold of ≥1 (i.e., one or more instances of drinking ≥6 units/≥72 g of ethanol in one sitting during the past year), instead of ≥2 which is more often used (i.e., one or more instances of drinking ≥6 units/≥72 g of ethanol in one sitting during the past month), to identify older adults for whom any level of bingeing is strongly associated with adverse consequences [14].

Problems related to alcohol use were assessed with AUDIT items 4-10, often labelled AUDIT-P ("P" for problems). We examined those who scored ≥1 when summing the score on AUDIT items 4-10, thus reflecting any alcohol-related problem as done by others [36].

Statistics

Continuous variables are presented as the mean (SD), and categorical variables are presented as counts (%). Chi-square tests were used to assess associations between drinking categories and sociodemographic and health characteristics.

We used logistic regression models to assess the association between the at-risk drinking outcome variables as binary responses and sociodemographic and health characteristics as independent variables. To examine whether the effect of the independent variables differed for men and women, we tested for interaction by including two-way cross product terms in the models. We observed significant interactions between at-risk drinking and most of the independent variables. Thus, all logistic regression analyses were stratified by sex (men and women). Each drinking category was analysed separately without creating mutually exclusive groups. At-risk drinkers were compared with low-risk drinkers, heavy episodic drinkers with non-heavy episodic drinkers, and participants experiencing some sort of alcohol problems with those not experiencing alcohol problems. Only participants responding affirmatively to having consumed alcohol during the last 12 months were included in these analyses. Due to the large sample size, listwise deletions for missing values were used. Three sets of logistic regression analyses were conducted to model various categories of at-risk drinking as a function of sociodemographic factors, perception of having enough social support, perception of general health, mental distress, and the use of sleeping pills. Associations between the dependent variables and sociodemographic characteristics and selected health variables were investigated, first in unadjusted models. Subsequently, we controlled for other variables by building multiple logistic regression models. Age and educational level were significantly associated with all drinking behaviours in both men and women and were included in the final models. The results are presented as odds ratios (ORs) with 95% confidence intervals (CIs). Levels of significance at both 0.05 and 0.01 are provided in the tables, but given the large sample size, the main findings at the 0.01 level are discussed in the article.

All analyses were conducted using IBM SPSS Statistics for Windows, version 27.

Results

Sample Characteristics

The mean age of the included older adults (n = 8,616) was 68.9 (SD 6.9) years, and 52% were women. Participants who had a higher level of education (>12 years) numbered 3,075 (37%), and 5,905 (73%) lived with a spouse. Overall, 5,382 (63%) of the participants reported good or excellent health status, 1,034 (13%) had used sleeping pills during the last four weeks, 456 (6%) were mentally distressed, and 1,132 (14%) experienced not having enough social support (Table 1).

Drinking patterns

Overall, 639 (14%) women and 305 (7%) men reported not drinking during the past year ($p < 0.01$). The prevalence of men versus women exceeding the sex- and older adult-specific threshold for at-risk drinking was not significantly different: the results were 46% in men and 44% in women ($p = 0.117$). Among 60- to 69-year -olds, 50% of women and 54% of men were at-risk drinkers; among 70- to 79-year -olds, 36% of both women and men were at-risk drinkers; and among 80- to 99-year -olds, 24% of women and 19% of men were at-risk drinkers. In the categories of heavy episodic drinking (AUDIT-3 ≥1) and alcohol problems (AUDIT items 4-10 ≥1), significant sex differences were found, with a higher prevalence among men than among women ($p < 0.001$ for both categories) (see Table 2). Among current drinkers who reported heavy episodic drinking, 19% of women and 43% of men reported this less than monthly, 2.4% of women and 10.5% of men reported this monthly, 0.9% of women and 3.2% of men reported this weekly, and 0.1% of women and 0.3% of men reported this daily or almost daily.

Significant bivariate associations between at-risk drinking and several of the determinants were also observed. At-risk drinking was more prevalent among persons of lower age, with higher educational levels, who were living with a spouse or partner, who had enough social support, who had better self-rated health status, and those who were mentally distressed.

Factors associated with different patterns of at-risk drinking

The sex-stratified logistic regression modelling of at-risk drinking patterns confirmed but also differentiated some

Table 2 Prevalence of drinking patterns according to selected characteristics: Participants ≥60 years ($n = 8,616$) in the Tromsø survey (2015-16)

Characteristics	Full sample ($n = 8,616$)		Different patterns of drinking, current drinkers ($n = 7,672$)		
	Non-drinkers, n (%)	Low-risk drinking, n (%)	At-risk drinking[e], n (%)	Heavy episodic drinking[f], n (%)	Alcohol problems[g], n (%)
Overall prevalence	944 (11.1)	4,173 (55.0)	3,409 (45.0)	3,004 (39.9)	1,644 (22.1)
Sex					
Female	639 (14.6)[a]	2,099 (55.9)[a]	1,653 (44.1)[a]	844 (22.7)[a]	446 (12.1)[a]
Male	305 (7.4)[a]	2,074 (54.2)[b]	1,756 (45.8)[b]	2,160 (56.8)[a]	1,198 (31.9)[a]
Age (years)					
60-69	368 (7.1)[a]	2,296 (48.0)[a]	2,484 (52.0)[a]	2,192 (46.1)[a]	1,245 (26.4)[a]
70–79	384 (14.5)[a]	1,449 (64.2)[a]	809 (35.8)[a]	720 (32.2)[a]	376 (17.1)[a]
≥80	192 (26.1)[a]	428 (78.7)[a]	116 (21.3)[a]	92 (17.3)[a]	23 (4.5)[a]
Educational level					
Elementary school	496 (16.4)[a]	1,661 (65.7)[a]	869 (34.3)[a]	923 (36.9)[a, b]	435 (17.7)[a]
High school	196 (8.9)[a]	1,098 (54.8)[a]	904 (45.2)[a]	801 (40.3)[b]	449 (22.7)[a]
College/university	193 (6.3)[a]	1,287 (44.8)[a]	1,587 (55.2)[a]	1,220 (42.6)[a]	731 (25.8)[a]
Relationship status					
Living alone	332 (15.2)[a]	1,095 (59.3)[a]	753 (40.7)[a]	653 (35.6)[a]	381 (21.3)[a]
Living with a spouse/partner	509 (8.7)[a]	2,843 (52.9)[a]	2.527 (47.1)[a]	2,227 (41.7)[a]	1,207 (22.8)[b]
Enough social support					
No	160 (14.2)[a]	561 (58.2)[a]	403 (41.8)[a]	405 (42.3)[a]	265 (28.3)[a]
Yes	733 (10.2)[a]	3,475 (54.1)[a]	2,950 (45.9)[a]	2,544 (39.9)[b]	1,347 (21.4)[a]
Self-reported health status					
Bad or very bad	103 (22.5)[a, b]	205 (57.7)[a]	150 (42.3)[a]	131 (37.6)[a]	98 (28.8)[a, b]
Neither good nor bad	382 (14.5)[a, b]	1,342 (59.8)[b]	903 (40.2)[b]	862 (38.8)[b]	496 (22.7)[a]
Good	377 (8.4)[a]	2,206 (53.9)[a, b]	1,890 (46.1)[b]	1,649 (40.5)[c]	891 (22.1)[b]
Excellent	62 (7.0)[b]	373 (45.5)[a, b, c]	446 (54.5)[a, b, c]	340 (41.5)[d]	150 (18.4)[a, b]
Mental distress[h]					
No	761 (10.3)[a]	3,623 (54.5)[a]	3,026 (45.5)[a]	2,672 (40.5)[a]	1,434 (21.6)[a]
Yes	72 (16.0)[a]	186 (49.2)[a]	192 (50.8)[a]	147 (39.5)[b]	138 (36.6)[a]
Have used sleeping pills during last 4 weeks					
No	658 (9.5)[a]	3,397 (54.3)[a]	2,862 (45.7)[a]	2,548 (40.9)[a]	1,370 (22.3)[a]
Yes	171 (16.7)[a]	453 (53.2)[b]	399 (46.8)[b]	279 (33.2)[a]	196 (23.4)[b]

Pairs that share superscript letters within the same independent variable category and column are significantly different (a, b, c, d — $p < 0.05$).

[e] AUDIT-C ≥3 for women and AUDIT-C ≥4 for men suggest at-risk alcohol use; [f] AUDIT-3 ≥1, ≥6 units (≥72 grams of pure ethanol) in one sitting at least once last 12 months; [g] AUDIT items 4-10 ≥1; [h] HSCL-10 cut-off ≥1.85

of the bivariate associations observed in the full sample. We observed significant interactions in at-risk drinking by sex and increasing age group ($p = 0.017$), increasing educational level ($p < 0.001$), living with a spouse or partner ($p < 0.001$), having enough social support ($p = 0.045$), and increasing SRH ($p = 0.002$). In the heavy episodic drinking category, significant interactions were observed by sex and increasing age group ($p = 0.005$) and living with a spouse or partner ($p = 0.012$). In the alcohol problem category, significant interaction according to sex and increasing educational level was observed ($p = 0.021$).

Lower age and higher educational level were positively associated with exceeding an AUDIT-C threshold of ≥3 for women (Table 3) and ≥4 for men (Table 4). Better SRH status was positively associated with at-risk drinking in women, while this association was not observed in men. Living with a partner was positively associated with at-risk drinking in women but not in men. Having used sleeping pills during the last four weeks was positively associated with at-risk drinking in men but not in women.

Some of the bivariate associations not yielding significance in the full sample yielded significant associations in sex-stratified logistic regression analyses, and vice versa. For example, in bivariate analyses, the use of sleeping pills was not associated with at-risk drinking,

Table 3 Factors associated with different patterns of at-risk drinking: Women ≥60 years (current drinkers, *n* = 3,752) in the Tromsø survey (2015-16)

	At-risk drinking[a] (*n* = 1,653) vs. low risk drinking (*n* = 2,099)		Heavy episodic drinking[b] (*n* = 844) vs. no heavy episodic drinking (*n* = 2,871)		Alcohol problems[c] (*n* = 446) vs. no alcohol problem (*n* = 3,228)	
Predictor	**Adjusted OR†**	**95% CI**	**Adjusted OR†**	**95% CI**	**Adjusted OR†**	**95% CI**
Age (ref: 60-69)	1.00	ref	1.00	ref	1.00	ref
70–79	0.57**	0.50-0.67	0.51**	0.42-0.62	0.48**	0.37-0.62
≥80	0.30**	0.22-0.40	0.31**	0.21-0.48	0.03**	0.01-0.19
Educational level (ref group: Elementary school)	1.00	ref	1.00	ref	1.00	ref
High school	1.80**	1.52-2.12	0.85	0.69-1.05	1.18	0.90-1.55
College/university	2.65**	2.28-3.10	0.94	0.78-1.14	1.37*	1.07-1.75
Living with a spouse or partner (vs. living alone)	1.42**	1.22-1.64	0.95	0.80-1.14	0.71**	0.57-0.89
Enough social support (vs. not)	1.41**	1.12-1.77	0.98	0.74-1.30	0.70*	0.50-0.98
Self-reported health status (ref group: Bad or very bad)	1.00	ref	1.00	ref	1.00	ref
Neither good nor bad	1.40*	1.01-1.95	1.05	0.70-1.58	0.82	0.50-1.33
Good	1.66**	1.21-2.29	0.91	0.61-1.35	0.67	0.42-1.08
Excellent	2.33**	1.62-3.34	1.13	0.73-1.76	0.51*	0.30-0.88
Mental distress (vs. no mental distress)	0.92	0.71-1.18	1.02	0.75-1.39	2.83**	2.08-3.85
Have used sleeping pills during last 4 weeks (vs. no use last 4 weeks)	1.08	0.91-1.30	1.19	0.95-1.49	1.90**	1.46-2.48

OR Odds Ratio, *CI* Confidence Interval

[a] AUDIT-C ≥3, suggests at-risk alcohol use in women; [b]AUDIT-3 ≥1, ≥6 units (≥72 g of pure ethanol) in one sitting at least once last 12 months; [c]AUDIT items 4-10 ≥1

†Adjusted for age (continuous) and educational level

*$p \leq 0.05$ **$p < 0.01$

Table 4 Factors associated with different patterns of at-risk drinking: Men ≥60 years (current drinkers, *n* = 3,830) in the Tromsø survey (2015-16)

	At-risk drinking[a] (*n* = 1,756) vs. low risk drinking (*n* = 2,074)		Heavy episodic drinking[b] (*n* = 2,160) vs. no heavy episodic drinking (*n* = 1,645)		Alcohol problems[c] (*n* = 1,198) vs. no alcohol problem (*n* = 2,559)	
Predictor	**Adjusted OR†**	**95% CI**	**Adjusted OR†**	**95% CI**	**Adjusted OR†**	**95% CI**
Age (ref group: 60-69)	1.00	ref	1.00	ref	1.00	ref
70–79	0.50**	0.43-0.57	0.46**	0.40-0.54	0.57**	0.49-0.67
≥80	0.22**	0.16-0.31	0.15**	0.11-0.20	0.17**	0.11-0.27
Educational level (ref group: Elementary school)	1.00	ref	1.00	ref	1.00	ref
High school	1.24*	1.04-1.48	0.95	0.79-1.13	1.11	0.92-1.34
College/university	1.73**	1.48-2.04	0.90	0.76-1.06	1.19	1.00-1.41
Living with a spouse or partner (vs. living alone)	1.00	0.84-1.19	0.80*	0.67-0.96	0.82*	0.68-0.98
Enough social support (vs. not)	1.10	0.92-1.32	1.18	0.98-1.42	0.79*	0.66-0.96
Self-reported health status (ref group: Bad or very bad)	1.00	ref	1.00	ref	1.00	ref
Neither good nor bad	0.82	0.59-1.13	1.25	0.90-1.74	0.78	0.56-1.09
Good	0.87	0.64-1.19	1.32	0.96-1.82	0.64**	0.46-0.88
Excellent	0.84	0.58-1.21	1.19	0.82-1.74	0.46**	0.31-0.68
Mental distress (vs. no mental distress)	1.24	0.85-1.80	1.35	0.90-2.00	2.29**	1.59-3.32
Have used sleeping pills during last 4 weeks (vs.no use last 4 weeks)	1.58**	1.22-2.05	1.18	0.90-1.54	1.57**	1.20-2.05

OR Odds Ratio, *CI* Confidence Interval

[a] AUDIT-C ≥4, suggests at-risk alcohol use in men; [b]AUDIT-3 ≥1, ≥6 units (≥72 g of pure ethanol) in one sitting at least once last 12 months; [c]AUDIT items 4-10 ≥1

†Adjusted for age (continuous) and educational level

*$p \leq 0.05$ **$p < 0.01$

whereas sex-stratified modelling found that men, but not women, had a higher probability of at-risk drinking if they consumed sleeping pills. In contrast, some bivariate associations yielding significance in the full sample lost significance in sex-stratified models. For example, mental distress was associated with at-risk drinking in bivariate analyses. However, sex-stratified modelling showed results in the opposite direction for this correlation, and thus, this connection was offset. Sex-stratified modelling also showed that only women contributed to the association between better SRH status and at-risk drinking observed in the bivariate analyses. The same was true for the association between having enough social support and at-risk drinking.

Only increasing age was associated with a lower probability of heavy episodic drinking for both women and men. None of the other independent factors were associated with this drinking pattern in women, whereas living with a spouse or partner lowered the probability of heavy episodic drinking in men.

Increasing age, living with a spouse or partner, having enough social support, and better health reduced the probability of alcohol problems in both women and men. Mental distress and the use of sleeping pills were strongly associated with a greater likelihood of alcohol problems in both sexes. Educational level was not associated with any alcohol problems in men, whereas having a college or a university degree (at least an additional four years) was associated with a higher probability of alcohol problems in women.

Discussion

The overall prevalence of at-risk drinking among those aged 60-99 was found to be as high as 44% and 46% in women and men, respectively, when utilizing sex- and older adult-specific thresholds. Subjects of younger age (60-69 years) reported higher alcohol consumption and more prevalent at-risk drinking. In both sexes, at-risk drinking was associated with a higher level of education, with a stronger correlation in women. Women with better health were more likely to report at-risk drinking. This was also true for women living with a spouse or partner, or when they reported having adequate social support. Men who reported using sleeping pills were more likely to exceed at-risk drinking thresholds. This association was not found in women.

The finding of an equal prevalence of at-risk drinking in older women and men reflects substantial evidence that sex differences in alcohol consumption are reduced, and even absent in some age groups [1, 2, 12, 37–39]. The high prevalence of at-risk drinking, even among the oldest old, challenges the assumption that increased drinking among older people is a result of the baby boomers` more risky drinking patterns, as participants in both oldest age groups (70-79 years and 80 years and older) belong to the cohorts preceding the baby boomers. Furthermore, our findings stand in contrast to previous literature, which has shown that women reduce at-risk drinking more than men in old age [2, 5, 38]. Norwegian older adults have greater financial security, better health and welfare systems, and less social inequality than in the US and many other European countries, which may increase the availability and possibility of higher alcohol consumption [12]. Additionally, there is a high degree of gender equality, as women have increased their work participation and have improved the socioeconomic status relative to men's over the last decades [40]. Our findings may reflect a north-south gradient across European countries in values and attitudes towards gender equality, which results in more equal drinking between the sexes, as has been reported from other studies [12, 39, 40]. However, most older people in Norway report to drink frequently, but only a few alcohol units (one-two) on each occasion [11, 12]. This implies an AUDIT score ≥4, but may not involve risky drinking.

Both heavy episodic drinking and experiencing some sort of alcohol problem were strongly associated with male sex and lower age. This is in line with previous findings of an enduring sex gap in heavy drinking and alcohol use disorders [2, 17, 24, 38]. Men were less likely to drink heavily if they lived with a spouse or partner, whereas this association was not found in women. The fact that women drink heavily to a lesser extent than men has been suggested to be an expression of their role as controllers of the more risky drinking behaviours of men [41]. Although we found a considerably higher prevalence of heavy episodic drinking among men compared to women, i.e., 57% and 23%, respectively, it has been argued that AUDIT-3 underestimates health-impacting HED prevalence among older women [19]. The criterion of ≥6 drinks is not sex-adjusted according to different sensitivities to the adverse effects of alcohol and may be too high to identify harmful binge drinking among women. Our finding is in accordance with another study among older adults using the same AUDIT-3 threshold [19]; however, our study included older participants.

Factors associated with at-risk drinking

Our findings of a strong link between higher education levels and at-risk drinking in both sexes and with alcohol problems in women are in line with other recent studies that describe a strong correlation between a higher education level and unhealthy drinking, which is even stronger for women [21, 26, 40]. Existing research indicates a change in the current generation of older adults' perception of what behaviours are considered acceptable,

which may have affected alcohol habits, including among the healthy and highly educated elderly [6]. The suggested under-detection of alcohol problems may be related to the fact that clinicians do not suspect at-risk alcohol use in this privileged group of elderly individuals [13].

Loneliness is prevalent among older adults and has been considered a risk factor for harmful drinking [8, 26, 42]. It has, however, also been found that loneliness is associated with reduced frequency of alcohol use [43]. Others report that older people explain that alcohol drinking is linked to pleasant social gatherings and that increased social engagement is associated with increased drinking [44, 45]. Our findings support the latter; the assumption that having enough friends protects against harmful drinking could therefore not be confirmed by our study. Inconsistent findings across studies suggest that risky alcohol consumption is probably linked to loneliness in complex ways [26, 42–44, 46]. Divergent social and possibly gender-related norms for how to deal with loneliness and how alcohol is used in social settings across countries may explain some of the conflicting findings.

Our finding of a strong link between good or excellent health and at-risk drinking, and worse health status and abstention from alcohol among women, but not among men, was surprising. In a large longitudinal study from England, Holdsworth et al. found that drinking frequency later in life may be an indicator of health status rather than the cause of health status [47]. Our study suggests that alcohol consumption is an indicator of health status in women, but possibly not in men, in Norway. It is well-known that former drinkers often stop consuming alcohol when their health status worsens, which is known as the "sick quitters" effect [47]. Our findings indicate that this effect applies especially to older women, supporting findings of gender differences regarding risky health behaviours [41].

Our study did not find an association between mental distress and at-risk drinking as measured with AUDIT-C or AUDIT-3. However, a total score on AUDIT items 4-10 ≥1, indicating some sort of alcohol problem, was strongly associated with mental distress in both men and women. Despite the fact that a causal linkage between excessive alcohol use and depression among the general adult population has been found [48], this is not a consistent finding among the elderly [21, 49–51].

Our findings may indicate that some older adults with mental distress self-medicate with alcohol and consume more alcohol, while others, especially women, stop drinking (S. Table 1).

It has been found that the proportion of older adults who combine alcohol and medication, such as opioids and benzodiazepines, has increased [5] and that men combine sedative hypnotics with alcohol more often than women [52]. In our study, the use of sleeping pills was strongly associated with both exceeding at-risk drinking thresholds and experiencing some sort of alcohol problem in men, while it was only associated with experiencing some sort of alcohol problem in women. The finding of a higher probability of using sleeping pills when also experiencing alcohol problems is concerning, as concomitant use of alcohol and sedative hypnotics can exacerbate CNS depression, cause drowsiness and increase the risk of falls and confusion [9, 52].

The adequacy of using a lower consumption threshold for older adults, and even sex-specific thresholds, has been subject to some debate [16, 19]. Bush et al., who validated the abbreviated version of the Alcohol Use Disorders Identification Test (AUDIT-C), recommended a limit of ≥3 to indicate at-risk alcohol consumption [53]. Since then, this cut-off limit, which was validated in a cohort prone to alcohol abuse, has been criticized [54]. Poor sensitivity of a measure results in overestimation of prevalence; thus, increasing the standard AUDIT-C threshold can enable a more sensitive and specific screen. An AUDIT-C threshold of ≥5 for at-risk drinking in the general population samples has been suggested [54], with a threshold of ≥4 in older adults [55]. However, due to naturally lower levels of body water in women than in men and sex differences in alcohol metabolism, women are more susceptible to adverse effects of alcohol [56]. Even if there is a risk of overestimation of prevalence, it has therefore been argued that utilizing both sex- and older adult-specific thresholds more validly identifies at-risk drinkers [19]. Moreover, there is a strong correlation between an AUDIT-C score ≥3 for older women and ≥4 for older men and exceeding the alcohol consumption limits recommended by the NIAAA [57].

There is currently little knowledge about whether older adults who exceed different defined at-risk drinking limits will develop alcohol use disorders in the future or whether at-risk drinking is better tolerated in subgroups of the elderly. Nevertheless, potentially harmful drinking in this fast-growing segment of the population is widespread, and this requires increased attention from health care providers.

Clinical implications

The findings of this study may be particularly important for clinicians to help identify older adults who may be at higher risk of physical illnesses, injuries or other health-related consequences due to risky alcohol use. At-risk drinkers fit into the perception of "successful aging", with higher levels of education, better health and a larger degree of social satisfaction than low-risk drinkers, and

this is especially true for women. Additionally, not having enough social support, living alone, mental distress, and consuming sleeping pills may also indicate alcohol problems in older adults.

Limitations

The attendance rate was lower in the oldest age groups and may therefore be less representative of the general population. Although our findings among the oldest have reduced power, we decided not to exclude this age group, as few studies that have included the oldest age group (aged 80 years and older) have been conducted. Caution must therefore be exercised in interpreting these results.

Underreporting in studies based on self-reporting questionnaires, as in our study, is often considered a problem [58]. However, our findings of such a high proportion of older adults reporting to exceed suggested older-specific AUDIT thresholds, can indicate more liberal attitudes towards alcohol use in old age, as reported by others [6]. Reduced discomfort by reporting alcohol consumption correctly can imply that underreporting may be a minor problem among the new cohort of older adults as compared to older cohorts [12].

As this study is cross-sectional, it is not possible to predict whether the younger cohorts will reduce their alcohol consumption as they age in the same way as the older cohorts in this study. There is international evidence that older adults in the current baby boomer generation do not decrease drinking while aging [59, 60], including in Norway [11].

The cross-sectional nature of this study means that the interpretation of correlated findings is challenging. Prospective longitudinal studies are therefore essential to further broaden the understanding of the directions of relationships between risk factors and risk drinking.

Alcohol misuse, abstaining from alcohol ("sick quitter syndrome"), and mental distress are moderately associated with non-participation in population surveys [61, 62]. The underrepresentation of people with high alcohol consumption, abstainers and people with poor mental health should be taken into consideration when interpreting results from population-based health surveys. Furthermore, if the deleted cases due to missing values were not missing at random, listwise deletion may have caused some biases in the estimates.

Polypharmacy and comorbidity are major concerns in combination with elevated alcohol consumption [9]. We did not have access to data on self-reported medications other than sleeping pills, which implies a limitation in the interpretation of the results.

The Tromsø Study is based in the seventh largest Norwegian city, with relatively few immigrants, and it is limited with regard to ethnic diversity. The generalizability of the results may therefore be limited to Caucasian populations that are similar to older adults of Norwegian descent. Furthermore, people living in urban areas drink more than those in rural areas [11]. Since our sample does not include rural-living older adults, the generalizability in prevalence rates of alcohol consumption may be restricted to urban-living older adults.

Conclusions

Alcohol consumption is very prevalent among older adults in Norway, especially among highly educated adults. Furthermore, almost half of current drinkers exceeded sex- and older adult-specific thresholds for at-risk drinking among both women and men. At-risk drinking was strongly associated with very good health, living with a spouse or partner, and having adequate social support among women, while it was only associated with the use of sleeping pills among men. In both sexes, experiencing some sort of alcohol problem was associated with mental distress and the use of sleeping pills. Although the prevalence of at-risk drinking among those aged 60 years and older is high, it is not necessarily connected to alcohol-related harm. However, increased attention is required from health care professionals to detect and intervene in those at risk of health-related consequences due to excessive alcohol use. Future research should longitudinally investigate the health-related consequences of different patterns of at-risk drinking among the elderly.

Abbreviations

CI: Confidence interval; HED: Heavy episodic drinking. Drinking ≥6 units (≥72 grams of ethanol) in one sitting; OR: Odds ratio; SRH: Self-reported health status.

Glossary

AUDIT	Alcohol Use Disorders Identification Test. The AUDIT is a ten-item alcohol screen that can help identify persons who are at-risk drinkers. Items 4-10 consist of questions about the negative consequences of alcohol consumption (Problems).
AUDIT-C	Alcohol Use Disorders Identification Test-Consumption. The AUDIT-C is recommended for identifying at-risk drinking prevalence in older adults, consisting of the first three items from the AUDIT regarding consumption.
AUDIT-3	Consists of the third item of AUDIT-C and serves as an initial screen to identify binge drinkers.
At-risk Drinking	Refers to the consumption of alcohol, on any single occasion or on average during one week, or exceeding suggested older-specific AUDIT thresholds, that is considered risky to one's health. Specific definitions vary across the literature because there are a number of methodological and conceptual challenges [20].

Drinking Recommendations	Recommendations that help people drink safely by suggesting levels of consumption that have been shown to be low-risk for injury or harm. They are commonly based on a "typical" person.
HSCL-10	The Hopkins Symptom Check List-10. The suggested cut-off limit of HSCL-10 indicating mental distress is ≥1.85.
NIAAA	The US National Institute on Alcohol and Alcoholism is the lead federal agency for research on alcohol and health and the largest funder of alcohol research in the world (https://www.niaaa.nih.gov/about-niaaa).

Supplementary Information

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Additional file 1: Table S1. Factors associated with non-drinking, stratified by sex: Participants ≥60 years ($n = 8,616$) in the Tromsø survey (2015-16)

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Author's contributions

LTS conceptualized and designed the research. LTS acquired the data and performed statistical analysis. OKG, AH, RW and LTS handled funding and supervision. LTS drafted the initial manuscript. OKG, JGB, AH and RW made critical revisions of the manuscript for key intellectual content. All authors read and approved the final manuscript.

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Availability of data and materials

The legal restriction on data availability are set by the Tromsø Study Data and Publication Committee in order to control for data sharing, including publication of datasets with the potential of reverse identification of de-identified sensitive participant information. We have received administrative permission to access and use the data that support the findings of this study. A detailed overview of the data collection process, including links to the main questionnaires, can be found on the website of the Tromsø Study (https://uit.no/research/tromsostudy). We do not have permission to share the data, but readers may contact Professor Sameline Grimsgaard, sameline.grimsgaard@uit.no to request the data or receive a confirmation that data will be available upon reasonable request to researchers.

Declarations

Ethics approval and consent to participate

All participants provided written informed consent for participation in the study and to the scientific use of their health survey data. Tromsø 7 data collection was approved by the Regional Committee for Medical Research Ethics (REC North ref. 2014/940) and the Norwegian Data Protection Authority and performed in accordance with the 1964 Helsinki declaration and its later amendments. This study is part of a research project approved by the REC North (case reference 2020/96868).

Consent for publication

Not applicable.

Competing interests

The authors declare no conflict of interest.

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Publisher's Note

Appendix Table 9 Factors associated with non-drinking in Tromsø7

Predictor	**Men** Non-drinker (n=305) vs. current drinker (n=3,830)		**Women** Non-drinker (n=639) vs. current drinker (n=3,752)	
	Adjusted OR	95% CI	Adjusted OR	95% CI
Age (ref group: 60-69)	1.00	ref	1.00	ref
70–79	1.75**	1.34-2.29	2.15**	1.77-2.61
≥80	3.77**	2.67-5.34	3.58**	2.74-4.67
Education (ref group: Elementary school)	1.00	ref	1.00	ref
High school	0.73*	0.55-0.98	0.56**	0.44-0.70
College/university	0.50**	0.37-0.67	0.46**	0.36-0.73
Living with a spouse or partner (vs. living alone)	0.65**	0.49-0.87	0.72**	0.59-0.87
Enough social support (vs. not)	0.73*	0.53-0.99	0.63**	0.49-0.81
Self-reported health status (ref group: Bad or very bad)	1.00	ref	1.00	ref
Neither good nor bad	0.94	0.57-1.54	0.44**	0.32-0.61
Good	0.58*	0.36-0.96	0.29**	0.21-0.40
Excellent	0.78	0.42-1.44	0.23**	0.14-0.36
Mental distress (vs. no mental distress)	1.66	0.91-3.02	1.82**	1.32-2.51
Have used sleeping pills during last 4 weeks (vs. no use last 4 weeks)	1.20	0.80-1.81	1.37**	1.09-1.72

OR, Odds Ratio; CI, Confidence Interval. †Adjusted for age (continuous) and educational level
*p≤0.05 **p<0.01

Paper 3

The effects of exceeding low-risk drinking thresholds on self-rated health and all-cause mortality in older adults: The Tromsø study 1994-2020

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Abstract

Background

Based on findings of increasing alcohol consumption in older adults, it is important to clarify the health consequences. Previous knowledge has often relied on cross-sectional studies, which cannot control for changes in alcohol consumption and time-varying covariates. This study investigates the health-related consequences of exceeding the suggested low-risk drinking thresholds in older adults and includes repeated measures of alcohol consumption.

Methods

The sample is drawn from four surveys of the Tromsø study; Tromsø4 (1994–95), Tromsø5 (2001), Tromsø6 (2007–08) and Tromsø7 (2015–16), and uses an accelerated longitudinal design. A total of 24,590 observations of alcohol consumption were made in older adults aged 60-99 (53% women). Primary outcome measures: Self-rated health and all-cause mortality. Data were retrieved from the Norwegian Cause of Death Registry. The follow-up time extended from the age of study entry to the age of death or end of follow-up on November 25, 2020. Predictor: Average weekly alcohol consumption (non-drinker, <100 g/week, ≥100 g/week)

Results

The multilevel random-effects models showed that women, but not men, who consumed ≥100 g/week had better SRH than those who consumed <100 g/week (OR 1.85, 95% CI 1.46-2.34). The Cox proportional hazard models identified an equal mortality risk between those who exceeded 100 g/week and those who consumed less than 100 g/week.

Conclusions

There was no clear evidence of an independent negative effect on self-rated health trajectories or mortality for exceeding the suggested low-risk drinking thresholds compared with abstinence or moderate drinking levels over a 25-year follow-up. Mental distress was the strongest independent predictor of poorer self-rated health and increased mortality risk. Some sex-specific risk factors in combination with high alcohol consumption lead to adverse effects on self-rated health. In men there was the use of sleeping pills or tranquilisers, and ≥20 years of smoking, in women there were physical illness and older age. Future research should investigate the effects of exceeding suggested low-risk thresholds in more vulnerable older adults, such as those receiving psychiatric treatment.

Key Words: Alcohol Consumption, Older adults, Self-Rated Health, Mental Distress, Sleeping pills, Longitudinal Study, The Tromsø Study, Norway

Background

The Baby Boom generation (born between 1946 and 1964) consumes more alcohol than the previous generations of older adults, but little is known about how these changing drinking habits affect mortality and health-related quality of life [4, 8, 30, 60, 126, 238]. Excessive alcohol consumption is associated with acute harms such as falls, injuries, and confusion as well as long-term effects linked to many diseases common in older adults [36, 37, 60]. Although it has been widely accepted that a J- or U-shaped association exists between alcohol consumption and adverse health outcomes and mortality, with a lower risk for moderate drinkers compared to abstainers or heavy drinkers [108, 173, 193-195], recent evidence casts doubt on whether any beneficial health effect of alcohol exists [16, 103, 192, 196, 199]. Defining separate older-adult "low-risk" drinking thresholds may have a physiological rationale, as lean body mass and total body water decrease with increasing age, resulting in higher levels of blood alcohol from the same amount of alcohol compared to younger people [60]. Additionally, due to a higher prevalence of prescription and over-the-counter medications and increasing somatic and mental illnesses with increasing age, research in older adults on the health consequences of alcohol consumption is necessary [89, 273, 274]. However, some studies indicate that older adults may tolerate alcohol just as well as their younger counterparts [178, 190, 275]. Nevertheless, a life situation altered by retirement; illness; loss of a spouse, partner, family members or friends; loneliness; or hopelessness may facilitate negative health consequences of alcohol consumption [60, 242]. Despite sparse evidence that older adults may tolerate alcohol quite well, an increase has been reported in alcohol-related hospital admissions among older adults [7, 8, 262]. Hence, the current knowledge on the health consequences of increasing alcohol consumption among older adults is inconsistent.

Self-rated health (SRH) is a subjective measure of the current state of health. SRH has been widely used in population surveys and is a well-known predictor of future health outcomes, use of health services, and mortality in adults over 60 years, even in populations without a known disease burden [183-185], including this study population [186]. Physical illnesses, mental health, sex and social context are related to SRH, especially in older adults [189]. The novelty of using SRH as an outcome indicator for the health consequences of alcohol consumption is its ease of use because it only consists of a single question, and its ability to predict the use of health services and health expenditures [187, 188]. Evidence suggests that SRH captures a wide range of health dimensions, including physical, psychological, and functional health [183, 186]. Understanding the mechanisms for

maintaining good SRH in aging in all sexes, as well as risk factors for poorer SRH, can identify opportunities for health promotion and interventions [184, 185].

Although the relationship between alcohol consumption and mortality in older adults has been investigated to some extent, the findings are inconsistent due to the use of different alcohol measures (e.g., average consumption, accumulated consumption, frequency of consumption, binge drinking), few studies with repeated measures on alcohol consumption introducing reversed causality (sick quitters), and weak adjustment for confounders [103, 190, 193, 194, 199, 273]. Findings are also inconsistent on whether women and men have differing mortality risks from the same levels of alcohol use, some indicating that older women tolerate alcohol as well as older men [185, 190, 192]. To the best of our knowledge, no studies have longitudinally examined the relationships between alcohol and the health-related consequences measured with SRH and mortality in a population of older adults who have increased their alcohol consumption significantly [238].

Study aims

I. Investigate the longitudinal relationship among alcohol consumption, self-rated health (SRH) and all-cause mortality risk in a general population of older adults (aged 60 years or older).

II. Quantify the extent to which any independent effects of exceeding the low-risk drinking thresholds combined with the relevant risk factors leads to later consequences; i.e., whether subgroups have increased health risks due to high alcohol consumption.

Methods

This cohort study with repeated cross-sectional examinations was conducted in a general population living in a geographically defined area in Norway. The Tromsø study is an ongoing population-based cohort study conducted in the municipality of Tromsø, and consists of seven surveys (referred to as Tromsø1–7) [3]. The current study is based on the four latest surveys, Tromsø4 (1994–95), Tromsø5 (2001), Tromsø6 (2007–08) and Tromsø7 (2015–16). The overall attendance rates for participants aged 60 years and over were 78%, 87%, 69%, and 68%, respectively, in each consecutive wave. We excluded subjects who had missing values on alcohol consumption questions, leaving 5,805 (44 excluded), 4,261 (657 excluded), 6,169 (291 excluded), and 8,355 (261 excluded) participants, from each of the consecutive Tromsø surveys (24,590 observations overall, 53% women). Modelling of health trajectories

required at least two measuring points and thus included 20,840 observations (9,871 in men and 10,969 in women). Overall, 6,050 deaths were recorded in 15,517 unique participants during the study period.

Primary outcome measures: Self-rated health and all-cause mortality

SRH was the first outcome variable of interest and was measured by the following question: "How do you generally consider your own health?". The response alternatives were "bad/very bad"(1), "neither good nor bad/fair"(2), "good"(3), and "excellent"(4). All-cause mortality was the other outcome of interest. Time of death was retrieved from the Norwegian Cause of Death Registry (CoDR). Follow-up time extended from the date of first participation to the date of death, emigration or the end of study follow-up on November 25, 2020. The coverage of the CoDR is almost complete [206].

Independent of interest: Alcohol consumption

Alcohol consumption was measured with an adaptation of the Alcohol Use Disorders Identification Test-Consumption (AUDIT-C), which is an abbreviated version of the 10-item AUDIT) [208]. The AUDIT-C consists of three questions on the past year's frequency of drinking (never, monthly or less, 2-4 times a month, 2-3 times a week, or four or more times a week), the number of units consumed on a typical drinking day (1-2, 3-4, 5-6, 7-9, or 10 or more), and frequency of heavy episodic drinking (HED) defined as 6+ units (never, less than monthly, monthly, weekly, daily or almost daily). In Norway, one unit of alcohol is defined as 12 grams of pure ethanol. The questions on alcohol consumption differed slightly between the surveys. A comprehensive description of the alcohol consumption measurements and how they were operationalised for comparability is given elsewhere [238]. Abstainers were defined as participants who reported "never" drinking in the previous 12 months or answered "Yes" for teetotallers. The quantity of alcohol was estimated by multiplying the midpoint of each response to AUDIT Item 1 by the midpoint of each response to AUDIT Item 2, thus generating a volume in grams of ethanol per day. Weekly consumption (g/week) was subsequently recoded as a categorical variable with three levels (abstainers, <100 g/week, and ≥100 g/week), as there is some evidence for a low-risk drinking threshold of 100 g/week [103]. Heavy episodic drinking (i.e., 6+ in one sitting) was dichotomised, differentiating between participants with frequent (monthly or more often) or infrequent (less than monthly) binge drinking.

Covariates

Social and demographic variables. Age was measured as a continuous variable and additionally recoded into age groups of 60–64 years, 65-69 years, 70-74 years, and 75 years and older. Educational level was categorised as "primary/elementary school (up to 10 years)"(1), "secondary/upper secondary education (up to an additional three years)"(2), and "college/university/tertiary education (at least four additional years)"(3). Relationship status was assessed by the question "Do you live with a spouse/partner?", with the response alternatives of "Yes" or "No". Social support questions were "Do you have enough friends who can give you help and support when you need it?", and "Do you have enough friends you can talk confidentially with?" with the response alternatives of "Yes" or "No".

Health characteristics. Specially trained personnel measured nonfasting total cholesterol (mmol/l), blood pressure (systolic/diastolic blood pressure, mean of reading 2 and 3) and body weight and height (kg/m^2). The thresholds for high cholesterol (≥5.0 mmol/l) and high blood pressure (>140/90 mm Hg) were set according to national guidelines for the prevention of cardiovascular disease [211]. Body mass index (BMI) was categorised as "lean," (<25 kg/m^2) "overweight" (25-30 kg/m^2), or "obese" (≥30 kg/m^2). Known physical illness were self-reported as specific medical conditions reported in different surveys: psoriasis, food allergies, chronic bronchitis, migraine, ulcer, asthma, thyroid disease, arthritis, myocardial infarction, cerebrovascular stroke, diabetes, osteoporosis, and angina. We used a validated measure of comorbid burden, the Health Impact Index (HII), which considers that each condition has a different impact on SRH [212]. HII was used as a continuous variable in the models and categorised as "Not ill" (0), "Mildly ill" (1-2), "Moderately ill" (3-5), and "Seriously ill" (≥6) in descriptive statistics. Mental distress was measured with validated questions on degree of anxiety and depression. Tromsø4 used the seven-item Cohort Norway Mental Health Index (CONOR-MHI), whereas Tromsø5-7 used the ten-item Hopkins Symptom Check List-10 (HSCL-10) [214]. The agreement between these questions has been examined with reasonably good compliance [215]. A cut-off of 2.15 for significant symptoms of CONOR-MHI is equivalent to 1.85 for HSCL-10. The suggested cut-off limits were used to estimate an ordinal measure of mental distress: "No symptoms" (0), "Some symptoms" (1), "Subthreshold symptoms" (2), and "Significant symptoms" (3). Self-reported use of sleeping pills or tranquilisers during the last two (Tromsø4) or four (Tromsø5-7) weeks was included

(not used, less frequently than every week, every week, but not daily, or daily). The response alternatives were dichotomised as “Have used” or “Have not used” sleeping pills/tranquilisers during the last two/four weeks. Data on smoking were measured by the question “How many years in all have you smoked daily?” and were subsequently recoded as “Never” (0), “<20 years” (1), and “≥20 years” (2). Physical activity level was estimated as an ordinal variable: “inactive”(0), “<one hour/week”(1), “1-2 hours/week”(3), and “3 or more hours/week”(3). High- and low-intensity activity levels were collapsed, and the highest number of hours per week was used.

Statistics

We performed the statistical analyses in four stages using STATA, version 17.0. See supplementary material for the full analysis plan. Stage 1: Descriptive characteristics. We calculated the variables' means, standard deviations, and percentages according to sex and alcohol consumption. Stage 2: SRH levels across surveys. We examined mean values of SRH according to age groups versus drinking thresholds for each survey.

Stage 3: Random-effects models. We fitted two-level logistic models for ordered responses with SRH as the dependent variable with drinking level as the predictor variable and with the time-varying covariates of each survey nested within subjects. Stage 4: Cox proportional hazards analyses. We estimated the hazard ratios and 95% confidence intervals for death according to alcohol consumption stratified by sex. Time extended from the age at study entry to the age of death, or end of follow-up on 30 November 2020. The average follow-up time was 11.7 years.

Results

Characteristics of participants according to drinking habits

The distribution of observations for each alcohol consumption category shows that more women than men abstained from alcohol, while more men consumed ≥100 g/week than women. The average alcohol consumption among participants exceeding 100 g/week was lower in women than men, i.e., 118.8 g/week (SD 48.9 g/week) and 139.0 g/week (SD 74.3 g/week), respectively. Heavy drinkers were younger, had a higher level of education, reported better SRH and fewer illnesses and were more physically active than moderate drinkers and abstainers. Women who reported higher levels of alcohol consumption more often reported having many friends, while female abstainers more often lived alone. More than half of

women and men who drank ≥100 g/week reported ≥20 years of daily smoking. Among participants who drank ≥100 g/week, the proportions who reported drinking 6+ units monthly or more often were 39% in men and 14% in women (Table 1).

Changes in sample characteristics from 1994 to 2016

A total of 6,255 participants participated four times, 8,122 participated three times, 6,461 participated two times, and 3,750 participated once. Alcohol abstention rates were reduced from 31% in 1994-95 to 11% in 2015-16. The proportion who reported alcohol consumption <100 g/week increased from 65% to 73%, while the proportion who reported exceeding 100 g/week increased from 4% to 16% during the study period. The proportion reporting "good" or "excellent" SRH increased from 45% in 1994-95 to 57% in 2015-16. The educational level increased for each consecutive wave, and the proportion with the highest level of education (college/university) increased from 10% in Tromsø4 to 37% in the latest survey. The proportion of never smokers increased from 23% to 38%. The proportion reporting to be "moderately" (HII=3-5) or "seriously" (HII=≥6) ill decreased from 38% to 16%, the proportion with hypertension (≥140/90 mmHg) decreased from 69% to 44%, and the proportion with hypercholesterolemia (≥5.0 mmol/l) decreased from 94% to 69% between Tromsø4 and Tromsø7 (S.Table 1).

Overall impact of exceeding 100 g/week of alcohol on self-rated health

The distribution of SRH for each alcohol consumption group according to age group for each wave is shown in Table 2. One-way ANOVA showed a significant correlation between alcohol consumption and SRH for most age groups in all panels. In pairwise comparisons, abstainers reported poorer SRH, while participants who drank ≥100 g/week reported higher levels of SRH. Comparing SRH according to alcohol consumption across surveys using the Kruskal–Wallis rank test, we found that a higher level of SRH was reported for each subsequent study for both moderate- and high-level drinkers but not for abstainers (p=0.547). The results from the multilevel random-effects models show that consuming ≥100 g/week was associated with higher levels of SRH in women but not in men (Table 3). This was true in both the univariate and fully adjusted models. In addition, abstaining from alcohol was strongly correlated with poorer SRH in both the univariate and fully adjusted models in women but only modestly in the univariate model in men.

Factors associated with self-rated health

Mental distress was the strongest independent predictor of poorer SRH in both women and men. The second strongest predictor was the use of sleeping pills or tranquilisers. A higher score on the HII (physical illness), ≥20 years of daily smoking, and being obese were individual risk factors predicting poorer SRH. Higher activity levels were increasingly beneficial, and physical activity at three hours a week or more increased the likelihood of improved SRH by two to three and a half times. Having enough friends/social support was also very beneficial for SRH and increased the odds of better SRH by two to three times.

Factors that moderate the impact of alcohol consumption on self-rated health

We found an interaction between alcohol consumption and age in women who exceeded 100 g/week, increasing the odds of reduced SRH by each ten-year period (OR 0.56, 95% CI 0.39-0.82), but this interaction was not significant in men. Figure 1 and Figure 2 show the postestimation plots. SRH declines for all three alcohol categories with increasing age. However, the models predict different trajectories according to sex for different alcohol consumption levels. Women have better SRH when exceeding 100 g/week than moderately drinking women and abstainers up to approximately 75 years of age, while the 95% CIs for the three categories overlap at older ages. The 95% CIs for the three categories overlap at all ages in men, but a steeper decline in SRH with increasing age is observed in men who drink heavily than in men who are abstainers or drink moderately.

The interaction between alcohol and morbidity (HII) showed no interaction in men exceeding 100 g/week (p=0.561) but was associated with poorer SRH in women (OR 0.87, 95% CI 0.78-0.98). Abstaining from alcohol increased the odds of better SRH for each increase in HII score; OR 1.13 (95% CI 1.04-1.22) in men, and OR 1.07 (95% CI 1.01-1.13) in women. In the interaction term between alcohol consumption and the use of sleeping pills or tranquilisers, exceeding 100 g/week was associated with poorer SRH in men (OR 0.60, 95% CI 0.37-0.99), whereas abstaining while using sleeping pills or tranquilisers was associated with better SRH (OR 2.46, 95% CI 1.33-4.56). This interaction was not significant in women. Interaction testing between alcohol consumption and smoking showed that men who had smoked for ≥20 years in combination and exceeded ≥100 g/week reported poorer SRH (OR 0.61, 95% CI 0.39-0.94). This interaction was not significant for women.

Overall impact of exceeding 100 g/week of alcohol on all-cause mortality risk

The mortality rates and hazard ratios for the alcohol consumption groups show that women had lower mortality rates than men according to all recorded alcohol consumption levels (Table 4). Abstaining women had almost twice the mortality rate (0.049) as moderately drinking women (0.025) and almost triple the mortality rate as high-level drinking women (0.015). The same pattern was found in men but was not as distinct as that in women. The survival plots show how the mortality risk was most pronounced for abstaining men and women but also that the curve falls more steeply for men than for women (Figure 3 and Figure 4). The results from the fully fitted Cox models show that the mortality risk was not increased in either women or men who consumed ≥100 g/week compared to those who consumed <100 g/week (Table 5). Abstinence was associated with 31% increased mortality risk in women (HR 1.31, 95% CI 1.18-1.46) and 18% in men (HR 1.18, 95% CI 1.06-1.32) relative to those who consumed <100 g/week. The mortality risk was attenuated when controlling for the covariates.

Factors associated with all-cause mortality risk

As expected, there was a strong relationship between SRH and all-cause mortality risk. A better SRH level ("good" or "excellent") reduced the hazard ratio by 50-75%. Daily smoking ≥20 years, mental distress, physical illness, and hypertension were independently associated with increased mortality risk. Living with a spouse or a partner, being overweight or obese, and having a higher level of physical activity were independent factors associated with decreased mortality risk. Use of sleeping pills or tranquilisers was associated with a reduced mortality risk in women but not in men.

Factors that moderate the impact of alcohol consumption on all-cause mortality risk

We found no significant interactions between alcohol consumption and any of the listed covariates on mortality risk.

Sensitivity analyses

Similar hazard ratio results were obtained when we excluded participants who died within the first year after inclusion to control for those who were already sick. In these analyses, the number of participants was reduced from 15,117 to 13,922 (52% women). The results from the fully fitted models only differed at the second decimal places and beyond. We also repeated our analyses separately for participants born before and after 1946 to compare the effect of exceeding 100 g/week in Baby Boomers, who have increased their alcohol

consumption, with the “dry” Pre-War II generation. The results were qualitatively identical in the two cohorts, although the premature mortality risk in the abstaining Baby Boom women was more significant than in the Pre-War II women (S.Table 2). A wider CI band in mortality risk by alcohol consumption indicates greater heterogeneity in the Baby Boom cohort than in the Pre-War II cohort, possibly due to biases introduced by shorter follow-up time. However, we cannot rule out that this difference implies a change in mortality risk due to changed alcohol habits in the new cohort of older adults.

Discussion

In this cohort study with up to 25 years of follow-up, we found no clear evidence of an independent negative effect of exceeding the suggested low-risk drinking thresholds on either SRH or mortality risk when compared with moderate drinking levels in community-dwelling older adults. However, we identified sex-specific differences in the association between alcohol consumption and SRH. A strong positive correlation between a high alcohol consumption and better SRH and a negative correlation between abstaining from alcohol and poorer SRH were identified in women but not in men. The positive relationship between high alcohol consumption and better SRH in women weakened with increasing age. Furthermore, some differences between men and women in risk factors that moderated the relationship between alcohol consumption and SRH were identified.

Even if we found no independent relationship between alcohol consumption and SRH in men, we found that sleeping pills or tranquilisers increased the adverse effect of high alcohol consumption on SRH. This finding concurs with other findings of an increased risk of alcohol problems or increased mortality among older men who report the use of sleeping pills or drugs with addiction potential [153, 239, 255]. Moreover, a bidirectional association between sleeping problems and high alcohol consumption has been reported in men but not in women [153]. This implies that a subgroup of men who are prescribed sleeping pills or tranquilisers are at increased risk of a negative impact of alcohol on SRH.

In contrast to other findings that binge drinking is particularly harmful in older adults [37, 96, 108, 109], our study did not find that frequent binge drinking was a significant confounder or moderator for either SRH or all-cause mortality. Others have reported similar findings, which may imply that binge drinking is an imprecise measure to identify harmful uses of alcohol [177, 260]. Having enough friends and social support and a higher activity level were independent beneficial factors for SRH in both sexes. A larger proportion of

female heavy drinkers reported being socially satisfied and more physically active than male heavy drinkers. Although there was a lack of clear evidence for a moderating effect, these factors may have mediated a beneficial effect of high alcohol consumption in some women. Our findings may indicate that women and men adjust the risk factors differently so that women maintain better SRH even if they exceed the low-risk drinking thresholds.

The average SRH level improved during the study period. Furthermore, the proportion who had never smoked increased, the proportion with severe physical illness decreased, and the proportion with hypertension or hypercholesterolemia decreased. These findings indicate a healthier elderly population and may have reduced any adverse effects of increased alcohol consumption. In addition, average weekly alcohol consumption, even in the highest consumption group, was just above the threshold in women and not very high in men. This observation can be related to the fact that older adults in high-income western European countries, including Norway, drink level-headedly, i.e., they drink more frequently but consume relatively small amounts of alcohol on each occasion [4, 126, 238, 239]. Moreover, we observed that a higher proportion among the high-level drinkers was highly educated, lean (women), had normal blood pressure (women), had less physical illness, and reported more hours of weekly physical activity. This suggests that a large proportion of older drinkers' balanced risk factors are beneficial, which is in line with other findings [168, 249, 254].

Recent Canadian guidelines recommend that older women drink no more than five alcoholic drinks per week and older men drink no more than seven per week [98]. Contrary to several other countries, Norway do not have sex- and older adult-specific recommendations on drinking thresholds [96, 97, 100]. However, over the last century, Norway has possibly had one of the most restrictive alcohol policies in Europe and among the lowest alcohol per capita consumption (APC) [16, 45]. Strongly influenced by Skog`s theory of the collective components in drinking habits, alcohol sales in Norway are strictly regulated, have limited availability through designated stores, and are relatively expensive due to high taxes [44]. Recent evidence advocates that universal policies targeting APC have the most significant impact on public health, as they are likely an efficient way to prevent people from becoming very heavy drinkers [246, 260]. Our findings do not support the assertion that most older adults need lower limits of regular alcohol use than their younger counterparts, which is in line with other research [190, 255, 275].

Strengths and limitations

Important strengths of the Tromsø study are the high number of participants and the high proportion of attendance, which ensure that the results are representative of the general population. However, the rates of attendance in the oldest age groups were lower than those in the younger age groups and may therefore be less representative. It was probably healthier subjects who participated, which may have biased the results toward participants who tolerated alcohol better. Furthermore, the participation rate in the Tromsø Study has declined in the consecutive surveys, which may have led to further bias [3]. Excessive alcohol use, abstention from alcohol, and mental distress correlate with nonparticipation [224]. Moreover, a cohort effect has been found in the importance of mental well-being on SRH, with increasing importance across cohorts [189, 276]. Thus, possible underrepresentation of older adults with excessive alcohol consumption and poor mental health requires caution when interpreting the results from our study.

The methodology of multilevel random-effects analysis is robust [219]. The sample size is large, and thus the power is strong. However, modelling of health trajectories required at least two measurements, which may have further biased our findings towards healthier participants. Nevertheless, the methodology ensures that data are not wasted for participants and occasions for which either the response or the covariates are missing, in contrast to more old-fashioned approaches such as listwise deletion or complete case analysis. Use of all available data is less susceptible to bias [219].

The data retrieved from the Tromsø study are based on citizens living in the seventh-largest Norwegian city, and with relatively few immigrants, the findings are therefore limited concerning ethnic diversity. Furthermore, Norwegian older adults have greater financial security, better health and welfare systems, and less social inequality than in many other European countries. Therefore, the generalisability of the results may be limited to Caucasian populations living in high-income western European countries.

Conclusion

In the present study, mortality risk in older adults who exceeded 100 g/week of alcohol was not increased compared to those who consumed less than 100 g/week over a 25-year follow-up period. Furthermore, exceeding the suggested low-risk thresholds showed no negative effect on SRH compared with moderate drinking. However, some risk factors were linked with reduced SRH and increased mortality risk. We recommend attention to older adults with high-level alcohol consumption who are mentally distressed, have physical illness, report poor SRH, have hypertension, live alone, have smoked for many years or are inactive.

Older men with high levels of alcohol consumption who are also prescribed sleeping pills or tranquilisers have an increased risk of adverse health consequences. Our study does not support sex- and older adult-specific recommendations for drinking thresholds in a general population of older adults, but the assumption of a protective effect of drinking on mortality while ignoring the dynamic relationship between poor health and drinking behaviour is probably ill-founded.

List of abbreviations

CI: Confidence interval
CONOR-MHI: Cohort Norway Mental Health Index
OR: Odds ratio
HED: Heavy episodic drinking (i.e., 6+ in one sitting)
HII: Health impact index
HSCL-10: Hopkins Symptom Check List-10
SRH: Self-rated health

Declarations

Ethics approval and consent to participate

All participants provided written informed consent for participation in the study and the scientific use of their health survey data. We excluded 302 out of 36,929 participants from our selection (with age range 25-99), as they did not consent to medical research. The Regional Committee has approved all data collection from the Tromsø study for Medical Research Ethics (REC), the Norwegian Data Protection Authority, and the study is performed in accordance with the 1964 Helsinki declaration and its later amendments. The present study is part of a research project approved by the REC North (case reference 2020/96868).

Consent for publication

Not applicable

Availability of data and materials

The legal restriction on data availability are set by the Tromsø Study Data and Publication Committee in order to control for data sharing, including publication of datasets with the potential of reverse identification of de-identified sensitive participant information. We have

received administrative permission to access and use the data that support the findings of this study. A detailed overview of the data collection process, including links to the main questionnaires, can be found on the website of the Tromsø Study (https://uit.no/research/tromsostudy). Data may be obtained from a third party and are not publicly available.

Competing interests

The authors declare no competing interests.

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Author contributions

LTS conceptualised and designed the research. LTS handled the funding. LTS acquired the data. GFL and LTS developed the models, performed statistical analysis and interpreted the results. GFL, OKG, AH, and RW handled supervision. LTS drafted the initial manuscript. GFL, OKG, JGB, AH and RW made critical manuscript revisions for key intellectual content. All authors read and approved the final manuscript.

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Table 1 Characteristics of the participants ≥60 years according to alcohol consumption the Tromsø4–7 (n=24,590)

	Abstainers		**<100 grams ethanol per week**		**≥100 grams ethanol per week**		***P*-value[e]**
	Women n (%)	Men n (%)	Women n (%)	Men n (%)	Women n (%)	Men n (%)	
Self-rated health							
Poor	291 (8.6)	116 (8.0)	405 (4.7)	370 (4.4)	23 (2.7)	80 (5.0)	<0.001
Fair	1,767 (52.2)	619 (42.9)	3,296 (37.9)	2,989 (35.2)	216 (25.6)	445 (27.6)	
Good	1,197 (35.4)	619 (42.9)	4,296 (49.3)	4,523 (53.2)	449 (53.3)	901 (55.9)	
Excellent	129 (3.8)	89 (6.2)	711 (8.2)	617 (7.3)	155 (18.4)	186 (11.5)	
Age group							
60-64 years	635 (18.7)	296 (20.4)	3,098 (35.4)	2,909 (34.1)	398 (47.0)	656 (40.5)	<0.001
65-69 years	715 (21.0)	318 (22.0)	2,444 (27.9)	2,366 (27.8)	232 (27.4)	508 (31.4)	
70-74 years	749 (22.0)	326 (22.5)	1,642 (18.8)	1,759 (20.6)	122 (14.4)	262 (16.2)	
75 years and older	1,302 (38.3)	508 (35.1)	1,566 (17.9)	1,492 (17.5)	95 (11.2)	192 (11.9)	
Total[†]	3,401 (70.1)	1,448 (29.9)	8,750 (50.6)	8,526 (49.4)	1,618 (65.6)	847 (34.4)	
Educational level							
Elementary school (up to 10 years)	2,587 (77.0)	860 (59.9)	4,423 (50.9)	3,500 (41.3)	160 (19.0)	293 (18.2)	<0.001
High school (up to an additional three-four years)	513 (15.3)	368 (25.6)	2,341 (26.9)	2,691 (31.8)	251 (29.8)	465 (28.9)	
College/university, short and long	259 (7.7)	207 (14.4)	1,928 (22.2)	2,277 (26.9)	431 (51.2)	851 (52.9)	
Relationship status							
Live with a spouse or a partner	1,527 (52.3)	1,027 (77.9)	5,103 (62.6)	6,714 (81.7)	587 (71.8)	1,317 (83.5)	<0.001

Live alone	1,393 (47.7)	291 (22.1)	3,047 (37.4)	1,506 (18.3)	230 (28.2)	261 (16.5)	
Enough friends and social support							
Yes	2,536 (85.3)	1,106 (86.3)	7,487 (89.9)	7,243 (89.2)	777 (92.6)	1,424 (89.5)	<0.001
No	436 (14.7)	176 (13.7)	839 (10.1)	880 (10.8)	62 (7.4)	167 (10.5)	
Average physical activity per week							
Inactive	794 (24.1)	257 (18.1)	960 (11.2)	840 (10.0)	52 (6.3)	143 (8.9)	<0.001
<1 Hour	568 (17.2)	212 (14.9)	1,489 (17.4)	1,776 (21.1)	121 (14.6)	318 (19.8)	
1-2 hours	898 (27.2)	376 (26.4)	2,852 (33.3)	2,533 (30.2)	306 (36.8)	465 (29.0)	
≥3 hours	1,038 (31.5)	577 (40.6)	3,269 (38.1)	3,251 (38.7)	352 (42.4)	677 (42.2)	
Health impact index (HII)[a]							
Not ill (HII=0)	1,057 (31.1)	552 (38.1)	3,136 (35.8)	4,107 (48.2)	379 (44.7)	915 (56.6)	<0.001
Mildly ill (HII=1-2)	815 (24.0)	417 (28.8)	2,707 (30.9)	2,320 (27.2)	284 (33.5)	427 (26.4)	
Moderately ill (HII=3-5)	894 (26.3)	321 (22.2)	1,854 (21.2)	1,505 (17.6)	144 (17.0)	216 (13.3)	
Seriously ill (HII≥6)	635 (18.7)	158 (10.9)	1,054 (12.0)	594 (7.0)	40 (4.7)	60 (3.7)	
Body Mass Index							
Lean (<25 kg/m2)	1,077 (32.0)	481 (33.5)	3,286 (37.7)	2,594 (30.5)	398 (47.2)	458 (28.3)	<0.001
Overweight (25-30 kg/m2)	1,338 (39.7)	721 (50.2)	3,564 (40.9)	4,279 (50.3)	339 (40.2)	846 (52.4)	
Obese (≥30 kg/m2)	954 (28.3)	234 (16.3)	1,866 (21.4)	1,627 (19.1)	107 (12.7)	312 (19.3)	
Blood pressure							

< 140/90 mmHg	1,082 (31.9)	587 (40.5)	4,057 (46.4)	3,955 (46.4)	457 (54.1)	727 (45.0)	<0.001
≥ 140/90 mmHg	2,311 (68.1)	861 (59.5)	4,681 (53.6)	4,563 (53.6)	388 (45.9)	888 (55.0)	
Total cholesterol							
< 5.0 mmol/l	425 (12.5)	434 (30.1)	1,267 (14.5)	2,401 (28.2)	108 (12.8)	433 (26.8)	<0.001
≥ 5.0 mmol/l	2,963 (87.5)	1,008 (69.9)	7,445 (85.5)	6,105 (71.8)	736 (87.2)	1,182 (73.2)	
Never smoked	1,666 (60.2)	393 (29.0)	3,051 (37.8)	1,959 (23.8)	236 (28.6)	365 (23.1)	<0.001
>1-20 years	270 (9.8)	201 (14.8)	1,394 (17.3)	1,381 (16.8)	159 (19.3)	298 (18.9)	
≥20 years	832 (30.1)	760 (56.2)	3,621 (44.9)	4,889 (59.4)	429 (52.1)	916 (58.0)	
Mental distress[b]							
No symptoms	582 (18.2)	413 (29.4)	1,935 (23.2)	3,010 (36.3)	218 (26.5)	580 (36.1)	<0.001
Some symptoms	1,461 (45.7)	675 (48.1)	3,792 (45.5)	3,756 (45.2)	361 (43.9)	687 (42.8)	
Sub-threshold symptoms	767 (24.0)	229 (16.3)	1,893 (22.7)	1,226 (14.8)	169 (20.5)	252 (15.7)	
Significant symptoms	384 (12.0)	86 (6.1)	723 (8.7)	311 (3.7)	75 (9.1)	86 (5.4)	
Use of sleeping pills/tranquilisers[c]							
Not used last 2/4 weeks	2,538 (74.6)	1,215 (83.9)	6,741 (77.0)	7,581 (88.9)	669 (79.0)	1,383 (85.5)	<0.001
Have used last 2/4 weeks	863 (25.4)	233 (16.1)	2,009 (23.0)	945 (11.1)	178 (21.0)	235 (14.5)	
Heavy episodic drinking[d]							
6+ less frequently than monthly	3,105 (99.9)	1,301 (99.8)	7,301 (98.1)	6,893 (91.6)	696 (86.0)	937 (61.5)	<0.001
6+ monthly or more often	4 (0.1)	3 (0.2)	143 (1.9)	634 (8.4)	114 (14.0)	591 (38.7)	

Average alcohol consumption per week (SD)	0.0	0.0	13.8 (15.5)	18.2 (17.1)	118.8 (48.9)	139.0 (74.3)	<0.001

[†]Total = sex distribution in each alcohol consumption category. [a]HII measures physical illness according to the impact that each condition has on SRH. [b]In 1994-95, the seven-item CONOR Mental Health Index (CONOR-MHI) was used, whereas in the three subsequent surveys, the ten-item Hopkins Symptom Check List-10 (HSCL-10) was used. [c]The proportion includes the use of either or both sleeping pills/tranquilisers. In 1994-95, the time frame asked was "during the last *two* weeks", while in the three subsequent surveys it was "during the last *four* weeks". [d]Only participants <70 years were asked the question "how often do you drink 6+ units in one occasion" in 1994-95.

[e]*P*-values are based on chi square test for all categorical covariates, not stratified by sex: SRH: Pearson chi2(6) = 719.93, $p = < 0.000$; 5-year age group: Pearson chi2(6) = 1.3e+03, $p < 0.000$; Educational level: Pearson chi2(4) = 2.4e+03, < 0.000; Relationship status: Pearson chi2(2) = 330.10, $p < 0.000$; Social support: Pearson chi2(2) = 60.65, < 0.000; Activity level: Pearson chi2(6) = 516.30, $p < 0.000$; HII group: Pearson chi2(6) = 547.25, $p < 0.000$; BMI: Pearson chi2(4) = 69.85, $p < 0.000$; Hypertension: Pearson chi2(2) = 235.72, $p < 0.000$; Hypercholesterolemia: Pearson chi2(2) = 31.38, $p < 0.000$; Smoke: Pearson chi2(4) = 636.11, $p < 0.000$; Mental distress: Pearson chi2(6) = 208.38, $p < 0.000$; Use of sleeping pills: Pearson chi2(2) = 80.79, $p < 0.000$; Heavy episodic drinking: Pearson chi2(2) = 2.4e+03, $p < 0.000$. *P*-value for average alcohol consumption (continuous) is based on ANOVA: F(2) = 18267.32, $p < 0.000$.

Table 2 Cross-section of mean SRH according to alcohol consumption and 5-year age groups for each survey

	Abstainers		**<100 g/week**		**≥100 g/week**		*p*-value
	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	
Tromsø4							
60-64 years	246	2.52 (0.63)	913	2.56 (0.62)	61	2.66 (0.60)	<0.001
65-69 years	265	2.43 (0.59)	745	2.54 (0.62)	52	2.69 (0.61)	<0.001
70-74 years	223	2.44 (0.61)	463	2.55 (0.61)	18	2.83 (0.62)	<0.001
75 years and older	14	2.36 (0.84)	12	2.58 (0.67)	3	2.33 (1.15)	0.073
Tromsø5							
60-64 years	204	2.57 (0.67)	1,033	2.69 (0.63)	98	2.73 (0.65)	<0.001
65-69 years	219	2.53 (0.66)	797	2.63 (0.61)	64	2.83 (0.75)	<0.001
70-74 years	250	2.50 (0.61)	634	2.57 (0.64)	43	2.77 (0.61)	<0.001
75 years and older	367	2.33 (0.58)	503	2.48 (0.63)	31	2.72 (0.65)	<0.001
Tromsø6							
60-64 years	210	2.46 (0.77)	1,739	2.67 (0.73)	322	2.93 (0.75)	<0.001
65-69 years	218	2.47 (0.81)	1,159	2.70 (0.69)	171	2.82 (0.75)	<0.001
70-74 years	204	2.48 (0.76)	718	2.62 (0.70)	68	2.77 (0.76)	<0.001
75 years and older	394	2.30 (0.74)	675	2.51 (0.71)	51	2.63 (0.77)	<0.001
Tromsø7							
60-64 years	149	2.50 (0.79)	1,697	2.77 (0.73)	444	2.86 (0.71)	<0.001
65-69 years	163	2.51 (0.74)	1,657	2.75 (0.69)	365	2.82 (0.70)	<0.001
70-74 years	196	2.42 (0.77)	1,177	2.65 (0.69)	224	2.74 (0.71)	<0.001
75 years and older	366	2.37 (0.76)	1,059	2.57 (0.69)	156	2.69 (0.78)	<0.001

SRH; self-rated health, *p*-values are based on ANOVA comparing SRH in 5-year age groups according to drinking level and Tromsø survey. There was a significant difference in SRH across alcohol consumption levels for most age groups. Planned contrasts show that abstaining is associated with lower SRH, whereas drinking ≥100g/week is associated with higher SRH in all panels. Planned contrasts show that abstaining is not associated with changing SRH, while both moderate and high-level drinking are associated with improved SRH across time.

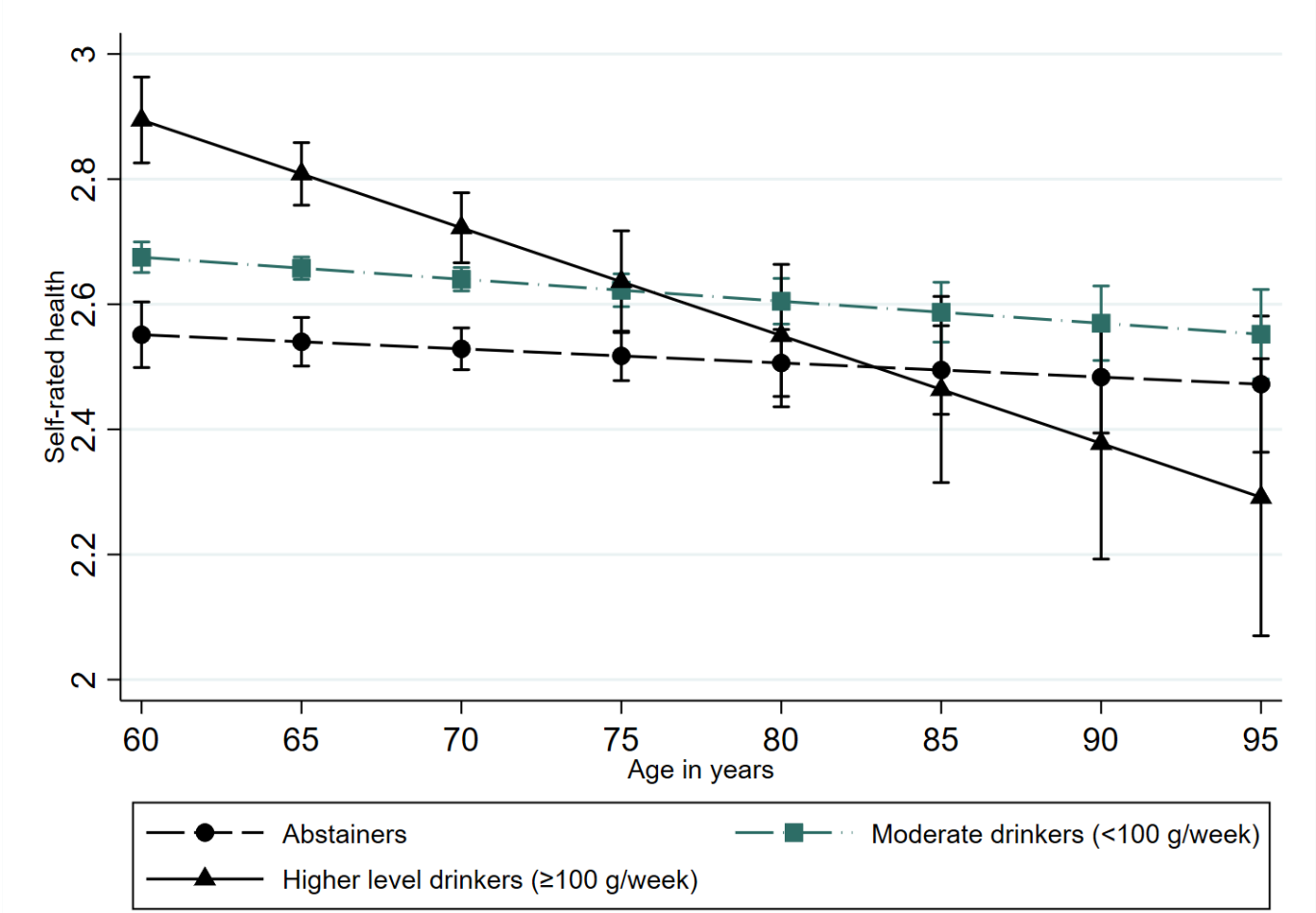
Table 3 Results from the random effects models with estimates for the association of subject-specific factors on SRH

	Women		Men	
	Univariate OR	Adjusted OR	Univariate OR	Adjusted OR
Alcohol consumption				
Abstainer, not consumed	0.49***	0.60***	0.76*	0.85
alcohol last 12 months	[0.42, 0.58]	[0.51, 0.72]	[0.61, 0.95]	[0.68, 1.07]
< 100 grams ethanol per week	1	1	1	1
	(ref.)	(ref.)	(ref.)	(ref.)
≥ 100 grams ethanol per week	1.90***	1.85***	1.13	1.18
	[1.49, 2.42]	[1.46, 2.34]	[0.94, 1.36]	[0.99, 1.42]
Mental distress[a]				
No symptoms	1	1	1	1
	(ref.)	(ref.)	(ref.)	(ref.)
Some symptoms	0.39***	0.41***	0.34***	0.39***
	[0.34, 0.45]	[0.35, 0.47]	[0.30, 0.39]	[0.34, 0.45]
Sub-threshold symptoms	0.10***	0.14***	0.11***	0.15***
	[0.09, 0.12]	[0.12, 0.17]	[0.09, 0.13]	[0.12, 0.18]
Significant symptoms	0.03***	0.05***	0.02***	0.04***
	[0.02, 0.03]	[0.04, 0.06]	[0.02, 0.03]	[0.03, 0.06]
Physical illness (HII)[b]	0.75***	0.77***	0.72***	0.74***
	[0.74, 0.77]	[0.75, 0.79]	[0.70, 0.74]	[0.72, 0.76]
Smoking				
Never smoked	1	1	1	1
	(ref.)	(ref.)	(ref.)	(ref.)
>1-20 years	1.11	1.05	0.73**	0.74**
	[0.91, 1.36]	[0.87, 1.27]	[0.59, 0.90]	[0.60, 0.91]
>20 years	0.61***	0.70***	0.35***	0.46***
	[0.52, 0.72]	[0.60, 0.81]	[0.29, 0.42]	[0.39, 0.55]
Have used pills[c] **last 2/4 weeks**	0.42***	0.69***	0.36***	0.70***
	[0.36, 0.48]	[0.60, 0.81]	[0.30, 0.43]	[0.57, 0.85]
Body Mass Index				
Lean (<25 kg/m2)	1	1	1	1
	(ref.)	(ref.)	(ref.)	(ref.)

Overweight (25-30 kg/m2)	0.78***	0.73***	0.91	0.83*
	[0.68, 0.90]	[0.63, 0.84]	[0.78, 1.06]	[0.71, 0.97]
Obese (≥30 kg/m2)	0.43***	0.47***	0.49***	0.53***
	[0.36, 0.52]	[0.39, 0.56]	[0.40, 0.59]	[0.43, 0.64]
Average physical activity per week				
Inactive	1	1	1	1
	(ref.)	(ref.)	(ref.)	(ref.)
<1 Hour	1.48***	1.12	1.33*	1.00
	[1.19, 1.84]	[0.88, 1.41]	[1.06, 1.68]	[0.79, 1.27]
1-2 hours	2.27***	1.49***	2.12***	1.50***
	[1.86, 2.77]	[1.20, 1.85]	[1.70, 2.65]	[1.19, 1.89]
≥3 hours	3.51***	2.25***	3.01***	2.10***
	[2.87, 4.30]	[1.81, 2.80]	[2.42, 3.75]	[1.67, 2.65]
Social support	2.77***	1.53***	2.14***	1.35**
	[2.27, 3.38]	[1.24, 1.90]	[1.76, 2.60]	[1.10, 1.66]

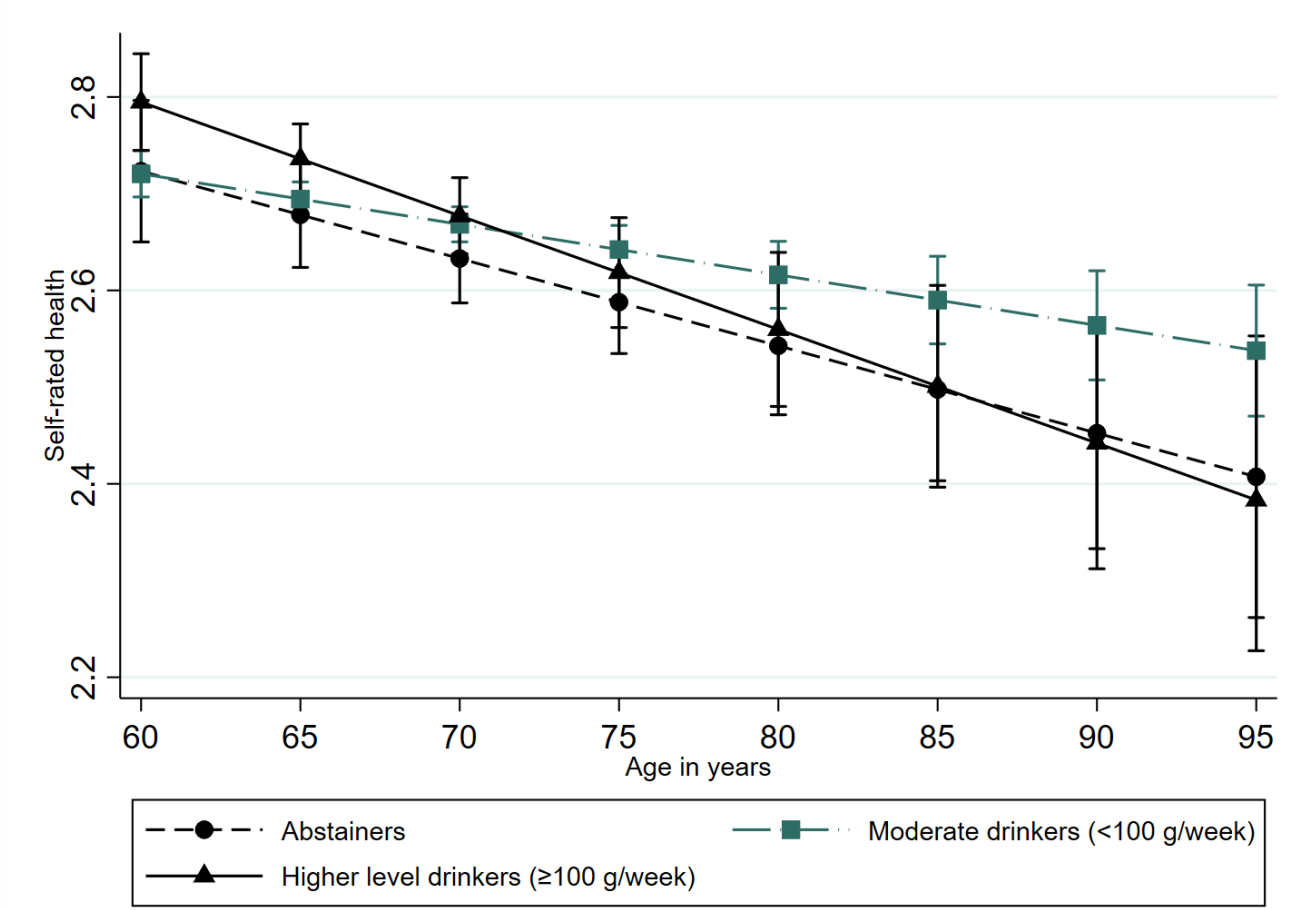
SRH; self-rated health. OR; odds ratio, are based on subjects participating ≥ two times with repeated measures of alcohol consumption (n=20,840). All time-varying scores were updated in 2001, 2007-08, and 2015-16 for those who participated. Exponentiated coefficients; 95% confidence intervals in brackets, all estimates are adjusted for education and age. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Univariate models: separate models for each risk factor, to estimate the independent effect on the ordinal response variable.
Adjusted models: fully fitted models including all listed covariates
[a]In 1994-95, the seven-item CONOR Mental Health Index was used, whereas in the three subsequent surveys, the ten-item Hopkins Symptom Check List-10 (HSCL-10) was used
[b]HII measures physical illness according to the impact that each condition has on SRH.
[c]Persons reporting the use of either or both sleeping pills/tranquilisers. In 1994-95, the time frame asked was "during the last *two* weeks", while in the three subsequent surveys it was "during the last *four* weeks".

Figure 1 Self-rated health trajectories in women ≥60 years according to alcohol consumption the Tromsø4–7



Results from the postestimation plot based on the fully fitted multilevel random-effects model of self-rated health including the interaction term (alcohol*age) in women (n=10,969). The analysis is based on subjects participating ≥ two times with repeated measures of alcohol consumption.

Figure 2 Self-rated health trajectories in men ≥60 years according to alcohol consumption the Tromsø4–7



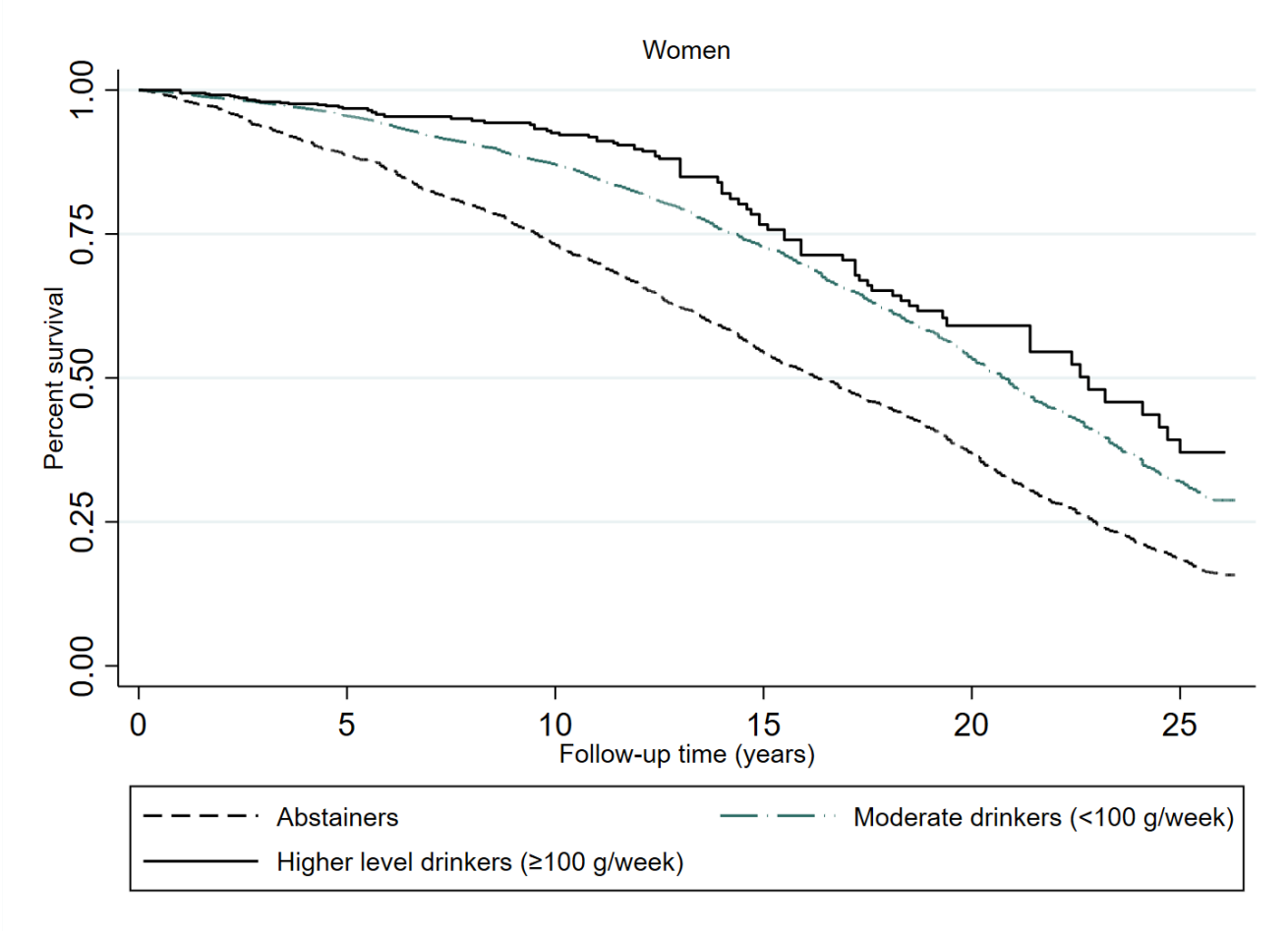
Results from the postestimation plot based on the fully fitted multilevel random-effects model of self-rated health including the interaction term (alcohol*age) in men (n=9,871). The analysis is based on subjects participating ≥ two times with repeated measures of alcohol consumption.

Table 4 Mortality rates according to alcohol consumption in subjects aged ≥60 years in the Tromsø4-7

	Person Time (Years)	Mortality rate	Number of subjects	Survival time (Years)			Hazard ratio (univariate)	Hazard ratio (adjusted)
				25%	50%	75%	95% CI	95% CI
Female abstainer	28,174	0.0486	2,348	9.5	16.3	23.0	1.53*** [1.42, 1.65]	1.31*** [1.18, 1.46]
Male abstainer	10,268	0.0595	1,010	6.9	13.8	21.0	1.37*** [1.25, 1.50]	1.18** [1.06, 1.32]
Female moderate drinker (<100 g/week)	66,260	0.0253	5,827	14.4	20.7	.	1 (ref.)	1 (ref.)
Male moderate drinker (<100 g/week)	59,667	0.0346	5,615	11.2	18.0	24.0	1 (ref.)	1 (ref.)
Female high-level drinker (≥100 g/week)	5,517	0.0152	700	15.5	22.8	.	0.89 [0.72, 1.11]	0.95 [0.73, 1.22]
Male high-level drinker (≥100 g/week)	10,499	0.0232	1,297	13.4	19.6	25.7	0.91 [0.79, 1.04]	0.89 [0.77, 1.03]
Total	180,384	0.0335	15,517	12.0	18.9	24.8		

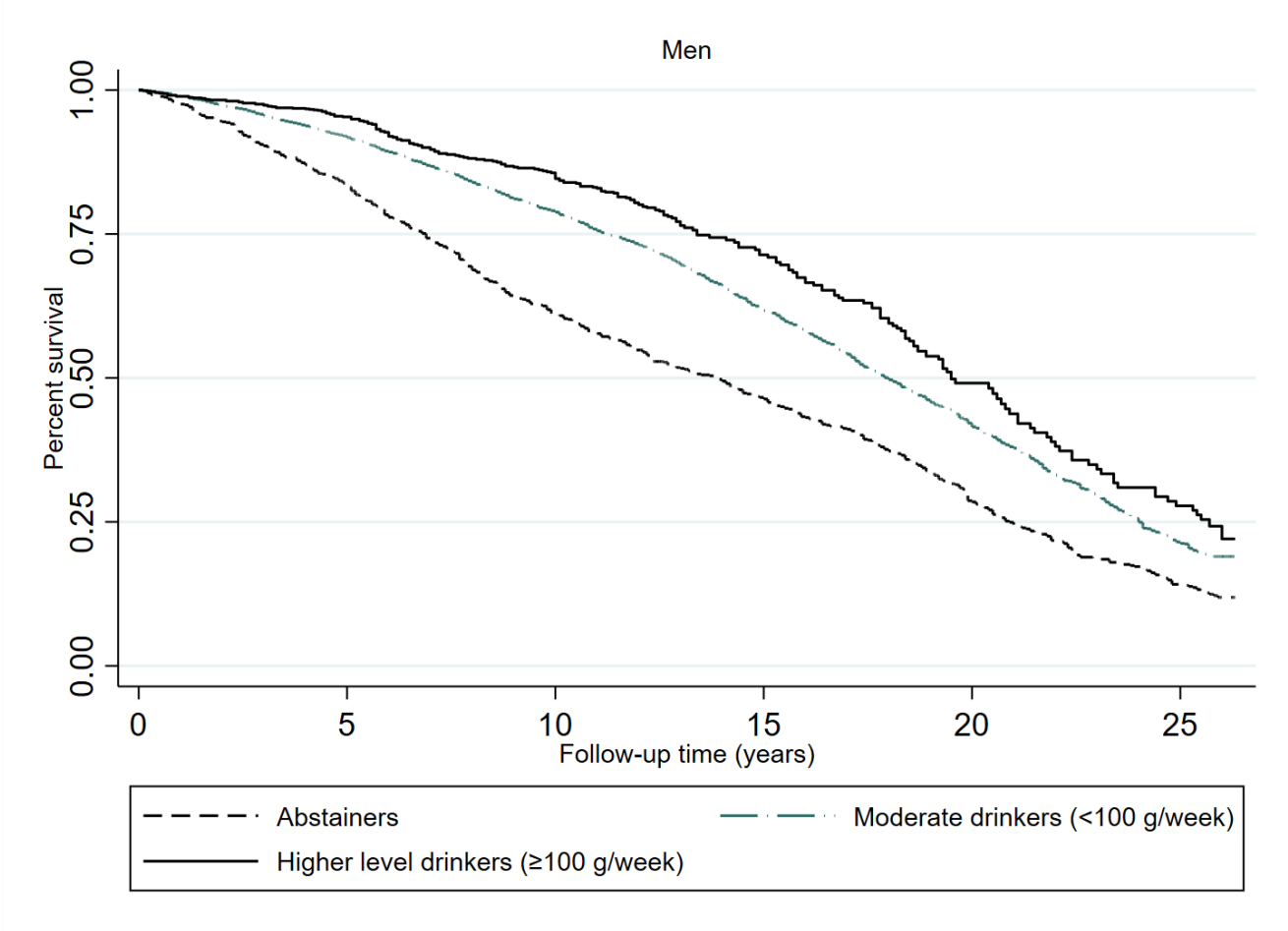
HR; hazard ratios, are based on cox proportional hazard models with repeated measures of alcohol consumption. All time-varying scores were updated in 2001, 2007-08, and 2015-16 for those who participated. End of follow-up on November 25, 2020.
Exponentiated coefficients; 95% confidence intervals in brackets, all estimates are adjusted for education and age. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
The univariate models include alcohol group stratified by sex, and controlled for educational level and age.
The adjusted models include alcohol group stratified by sex, and controlled for age, educational level, self-rated health, relationship status, mental distress, physical illness, smoking, use of sleeping pills or tranquilisers, high blood pressure, body mass index, and physical activity level.

Figure 3 Survival plot according to alcohol consumption level for women ≥60 years the Tromsø4–7.



Kaplan-Meier function based on cox proportional hazard models with repeated measures of alcohol consumption. Time extended from the age at study entry to the age of death, or end of follow-up on 30 November 2020. The average follow-up time was 11.7 years.

Figure 4 Survival plot according to alcohol consumption level for men ≥60 years the Tromsø4–7.



Kaplan-Meier function based on cox proportional hazard models with repeated measures of alcohol consumption. Time extended from the age at study entry to the age of death, or end of follow-up on 30 November 2020. The average follow-up time was 11.7 years.

Table 5 All-cause mortality risk by alcohol consumption in subjects aged ≥60 years in the Tromsø4-7

	Women		Men	
	Univariate HR	Adjusted HR	Univariate HR	Adjusted HR
Alcohol consumption				
Abstainer, not consumed alcohol last 12 months	1.53*** [1.42, 1.65]	1.31*** [1.18, 1.46]	1.37*** [1.25, 1.50]	1.18** [1.06, 1.32]
< 100 grams ethanol per week	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
≥ 100 grams ethanol per week	0.89 [0.72, 1.11]	0.95 [0.73, 1.22]	0.89 [0.77, 1.01]	0.89 [0.77, 1.03]
Self-rated health				
Poor	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Fair	0.75*** [0.66, 0.85]	0.86 [0.72, 1.02]	0.63*** [0.55, 0.71]	0.71*** [0.61, 0.83]
Good	0.50*** [0.44, 0.56]	0.61*** [0.50, 0.74]	0.40*** [0.35, 0.45]	0.55*** [0.46, 0.64]
Excellent	0.32*** [0.25, 0.41]	0.38*** [0.27, 0.53]	0.25*** [0.20, 0.31]	0.37*** [0.28, 0.49]
Live with a spouse or a partner	0.71*** [0.66, 0.77]	0.81*** [0.74, 0.89]	0.77*** [0.70, 0.84]	0.81*** [0.74, 0.90]
Mental distress[a]				
No symptoms	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Some symptoms	1.54*** [1.38, 1.73]	1.17* [1.02, 1.33]	1.68*** [1.53, 1.84]	1.31*** [1.18, 1.44]
Sub-threshold symptoms	1.55*** [1.37, 1.75]	1.07 [0.91, 1.24]	1.85*** [1.65, 2.08]	1.25*** [1.10, 1.43]
Significant symptoms	1.88*** [1.63, 2.18]	1.04 [0.86, 1.26]	2.31*** [1.96, 2.73]	1.36** [1.12, 1.66]
Physical illness (HII)[b]	1.05*** [1.04, 1.07]	1.05*** [1.03, 1.06]	1.08*** [1.07, 1.10]	1.07*** [1.05, 1.08]
Smoking				
Never smoked	1	1	1	1

	(ref.)	(ref.)	(ref.)	(ref.)
1-20 years	1.29***	1.12	1.35***	1.21*
	[1.11, 1.49]	[0.95, 1.32]	[1.15, 1.59]	[1.03, 1.44]
>20 years	1.95***	1.67***	2.49***	1.97***
	[1.78, 2.14]	[1.50, 1.86]	[2.21, 2.82]	[1.73, 2.24]
Have used pills[c] last 2/4 weeks	0.66***	0.78***	1.02	0.89
	[0.60, 0.72]	[0.70, 0.87]	[0.92, 1.14]	[0.80, 1.00]
High blood pressure (>140/90mmHg)	1.34***	1.15**	1.25***	1.26***
	[1.23, 1.45]	[1.04, 1.28]	[1.16, 1.35]	[1.16, 1.38]
Body Mass Index				
Lean (<25 kg/m2)	1	1	1	1
	(ref.)	(ref.)	(ref.)	(ref.)
Overweight (25-30 kg/m2)	0.72***	0.65***	0.73***	0.73***
	[0.66, 0.78]	[0.59, 0.73]	[0.68, 0.79]	[0.67, 0.80]
Obese (≥30 kg/m2)	0.76***	0.67***	0.68***	0.64***
	[0.69, 0.84]	[0.59, 0.76]	[0.61, 0.76]	[0.57, 0.73]
Average physical activity per week				
Inactive	1	1	1	1
	(ref.)	(ref.)	(ref.)	(ref.)
<1 Hour	0.61***	0.71***	0.57***	0.69***
	[0.54, 0.68]	[0.61, 0.83]	[0.51, 0.65]	[0.60, 0.79]
1-2 hours	0.57***	0.73***	0.58***	0.68***
	[0.51, 0.62]	[0.63, 0.83]	[0.52, 0.65]	[0.60, 0.78]
≥3 hours	0.59***	0.81**	0.63***	0.74***
	[0.54, 0.65]	[0.71, 0.93]	[0.57, 0.70]	[0.66, 0.84]

HR; hazard ratios, are based on cox proportional hazard models with repeated measures of alcohol consumption (n=24,590). All time-varying scores were updated in 2001, 2007-08, and 2015-16 for those who participated. End of follow-up on November 25, 2020. Exponentiated coefficients; 95% confidence intervals in brackets, all estimates are adjusted for education and age. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Univariate models: separate models for each risk factor, to estimate the independent effect on HR.

Adjusted models: fully fitted models including all listed covariates.

[a]In 1994-95, the seven-item CONOR Mental Health Index (CONOR-MHI) was used, whereas in the three subsequent surveys, the ten-

item Hopkins Symptom Check List-10 (HSCL-10) was used [b]HII measures physical illness according to the impact that each condition has on SRH. [c]Subjects reporting the use of either or both sleeping pills/tranquilisers. In 1994-95, the time frame asked was “during the last *two* weeks”, while in the three subsequent surveys it was “during the last *four* weeks”. [c]Subjects reporting the use of either or both sleeping pills/tranquilisers. In 1994-95, the time frame asked was “during the last *two* weeks”, while in the three subsequent surveys it was “during the last *four* weeks”.

S. Table 1 Characteristics of the participants ≥60 years according to survey in the Tromsø4–7 (n=24,590)

	1994-95	**2001**	**2007-08**	**2015-16**	**Total**
	n (%)	n (%)	n (%)	n (%)	n (%)
Age, sex and educational level					
60-64 years	1,554 (26.8)	1,346 (31.6)	2,396 (38.8)	2,696 (32.3)	7,992 (32.5)
65-69 years	1,525 (26.3)	1,080 (25.3)	1,594 (25.8)	2,384 (28.5)	6,583 (26.8)
70-74 years	1,260 (21.7)	927 (21.8)	1,016 (16.5)	1,657 (19.8)	4,860 (19.8)
75 years and older	1,466 (25.2)	908 (21.3)	1,163 (18.8)	1,618 (19.4)	5,155 (21.0)
Women	3,212 (55.3)	2,260 (53.0)	3,237 (52.5)	4,289 (51.3)	12,998 (52.9)
Men	2,593 (44.7)	2,001 (47.0)	2,932 (47.5)	4,066 (48.7)	11,592 (47.1)
Elementary school (up to 10 years)	3,729 (64.7)	2,575 (61.0)	2,480 (40.5)	3,039 (36.6)	11,823 (48.4)
High school (up to an additional three-four years)	1,462 (25.4)	986 (23.3)	1,969 (32.1)	2,212 (26.7)	6,629 (27.2)
College/university, short and long	569 (9.9)	663 (15.7)	1,679 (27.4)	3,042 (36.7)	5,953 (24.4)
Alcohol consumption, use of sleeping pills/tranquilisers					
Abstainer, not consumed alcohol last 12 months	1,785 (30.7)	1,046 (24.5)	1,075 (17.4)	943 (11.3)	4,849 (19.7)
>0<100 grams ethanol per week, (mean (SD))	3,767 (64.9) (13.4 (16.3))	2,979 (69.9) (13.0 (14.7))	4,451 (72.1) (16.2 (16.2))	6,082 (72.8) 19.1 (16.9)	17,279 (70.3)
≥100 grams ethanol per week, (mean (SD))	254 (4.4) (131.9 (54.6))	237 (5.6) (131.7 (63.0))	644 (10.4) (130.9 (66.3))	1,330 (15.9) (130.1 (63.0))	2,465 (10.0)
6+ less frequently than monthly[a]	3,363 (90.7)	3,854 (96.5)	5,568 (94.0)	7,453 (92.0)	20,238 (93.1)
6+ monthly or more often[a]	343 (9.3)	141 (3.5)	356 (6.0)	649 (8.0)	1,489 (6.9)
Have used pills[b] last 2/4 weeks	319 (5.5)	1,139 (26.7)	1,299 (21.1)	1,706 (20.4)	4,463 (18.1)
Not used pills[b] last 2/4 weeks	5,486 (94.5)	3,122 (73.3)	4,870 (78.9)	6,649 (79.6)	20,127 (81.9)
Self-rated health					
Poor	333 (5.7)	119 (2.8)	388 (6.3)	445 (5.3)	1,285 (5.2)
Fair	2,857 (49.3)	1,756 (41.5)	2,133 (34.7)	2,586 (31.1)	9,332 (38.1)
Good	2,398 (41.4)	2,125 (50.3)	3,050 (49.7)	4,412 (53.0)	11,985 (48.9)
Excellent	209 (3.6)	227 (5.4)	570 (9.3)	881 (10.6)	1,887 (7.7)
Social support, relationship status					
Live with a spouse or a partner	3,167 (69.1)	2,920 (69.4)	4,290 (70.7)	5,898 (72.4)	16,275 (70.8)
Live alone	1,415 (30.9)	1,285 (30.6)	1,779 (29.3)	2,249 (27.6)	6,728 (29.2)

Enough friends and social support					
Yes	3,899 (84.3)	3,693 (92.6)	5,386 (87.3)	7,595 (90.9)	20,573 (88.9)
No	724 (15.7)	293 (7.4)	783 (12.7)	760 (9.1)	2,560 (11.1)
Average physical activity per week					
Inactive	1,123 (19.4)	394 (9.4)	887 (14.9)	642 (7.8)	3,046 (12.6)
<1 Hour	673 (11.6)	443 (10.6)	1,489 (25.0)	1,879 (22.9)	4,484 (18.6)
1-2 hours	1,548 (26.7)	1,334 (31.8)	1,850 (31.1)	2,698 (32.9)	7,430 (30.8)
≥3 hours	2,448 (42.3)	2,022 (48.2)	1,723 (29.0)	2,971 (36.3)	9,164 (38.0)
Daily smokers					
Never smoked	1,055 (22.9)	1,444 (34.6)	2,162 (36.3)	3,009 (37.2)	7,670 (33.6)
>1-20 years	555 (12.0)	626 (15.0)	1,058 (17.8)	1,464 (18.1)	3,703 (16.2)
>20 years	2,997 (65.1)	2,107 (50.4)	2,733 (45.9)	3,610 (44.7)	11,447 (50.2)
Physical illness and metabolic risk factors					
Health impact index (HII)[c]					
Not ill (HII=0)	2,218 (38.2)	1,365 (32.0)	2,283 (37.0)	4,280 (51.2)	10,146 (41.3)
Mildly ill (HII=1-2)	1,370 (23.6)	1,125 (26.4)	1,792 (29.0)	2,683 (32.1)	6,970 (28.3)
Moderately ill (HII=3-5)	1,298 (22.4)	980 (23.0)	1,472 (23.9)	1,183 (14.2)	4,933 (20.1)
Seriously ill (HII≥6)	919 (15.8)	791 (18.6)	622 (10.1)	209 (2.5)	2,541 (10.3)
Body Mass Index					
Lean (<25 kg/m2)	2,347 (40.6)	1,451 (34.1)	1,930 (31.3)	2,575 (30.9)	8,303 (33.9)
Overweight (25-30 kg/m2)	2,504 (43.3)	1,932 (45.5)	2,872 (46.6)	3,800 (45.6)	11,108 (45.3)
Obese (≥30 kg/m2)	928 (16.1)	866 (20.4)	1,362 (22.1)	1,958 (23.5)	5,114 (20.9)
Blood pressure					
< 140/90 mmHg	1,809 (31.2)	1,742 (40.9)	2,608 (42.3)	4,706 (56.4)	10,865 (44.2)
≥ 140/90 mmHg	3,994 (68.8)	2,516 (59.1)	3,551 (57.7)	3,631 (43.6)	13,692 (55.8)
Total cholesterol					
< 5.0 mmol/l	379 (6.5)	527 (12.4)	1,551 (25.3)	2,611 (31.4)	5,068 (20.7)
≥ 5.0 mmol/l	5,410 (93.5)	3,724 (87.6)	4,589 (74.7)	5,716 (68.6)	19,439 (79.3)
Mental distress[d]					
No symptoms	414 (7.6)	1,390 (34.5)	1,973 (33.2)	2,961 (36.0)	6,738 (28.5)
Some symptoms	3,431 (62.7)	1,710 (42.4)	2,411 (40.6)	3,180 (38.7)	10,732 (45.3)
Sub-threshold symptoms	1,177 (21.5)	683 (17.0)	1,049 (18.4)	1,527 (19.1)	4,340 (19.0)
Significant symptoms	454 (8.3)	246 (6.1)	461 (7.8)	504 (6.1)	1,665 (7.0)

[a]Only participants <70 years were asked the question "how often do you drink 6+ units in one occasion" in 1994-95.
[b]The proportion includes the use of either or both sleeping pills/tranquilisers. In 1994-95, the time frame asked was "during the last *two* weeks", while in the three subsequent surveys it was "during the last *four* weeks".
[c]HII measures physical illness according to the impact that each condition has on SRH.
[d]In 1994-95, the seven-item CONOR Mental Health Index (CONOR-MHI) was used, whereas in the three subsequent surveys, the ten-item Hopkins Symptom Check List-10 (HSCL-10) was used

S.Table 2 All-cause mortality risk by alcohol consumption according to cohort in the Tromsø4-7

	Pre-War II generation (born before 1946)		**Baby Boomers (born after 1946)**	
	Women	Men	Women	Men
Alcohol consumption				
Abstainer, not consumed alcohol last 12 months	1.29*** [1.16, 1.44]	1.16** [1.04, 1.30]	2.37* [1.10, 5.13]	1.84 [0.82, 4.16]
> 0 < 100 grams ethanol per week	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
≥ 100 grams ethanol per week	0.96 [0.73, 1.26]	0.93 [0.80, 1.08]	1.17 [0.51, 2.69]	0.84 [0.45, 1.54]
Self-rated health status				
Poor	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Fair	0.88 [0.74, 1.05]	0.71*** [0.61, 0.84]	0.27** [0.10, 0.69]	0.53 [0.26, 1.10]
Good	0.62*** [0.51, 0.76]	0.55*** [0.46, 0.65]	0.23** [0.09, 0.60]	0.42* [0.19, 0.92]
Excellent	0.40*** [0.28, 0.57]	0.40*** [0.30, 0.53]	0.11** [0.03, 0.50]	0.00 [0.00]
Live with a spouse or a partner	0.82*** [0.74, 0.90]	0.81*** [0.74, 0.90]	0.76 [0.42, 1.37]	0.76 [0.44, 1.31]
Mental distress[a]				
No symptoms	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Some symptoms	1.17* [1.02, 1.35]	1.25*** [1.13, 1.39]	0.93 [0.47, 1.82]	1.90* [1.02, 3.53]
Sub-threshold symptoms	1.09 [0.93, 1.28]	1.20** [1.05, 1.38]	0.53 [0.23, 1.23]	2.34* [1.16, 4.74]
Significant symptoms	1.10 [0.90, 1.33]	1.30* [1.06, 1.59]	0.13* [0.03, 0.65]	2.94* [1.14,7.58]
Physical illness (HII)[b]	1.04*** [1.03, 1.06]	1.06*** [1.05, 1.08]	1.06 [0.92, 1.23]	1.08 [0.94, 1.24]

Smoking				
Never smoked	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
>1-20 years	1.12 [0.95, 1.33]	1.22* [1.03, 1.44]	1.61 [0.57, 4.50]	0.59 [0.19, 1.84]
>20 years	1.64*** [1.48, 1.83]	1.90*** [1.67, 2.17]	3.40** [1.52,7.58]	2.50** [1.31, 4.77]
Have used pills[c] last 2/4 weeks	0.78*** [0.70, 0.86]	0.90 [0.80, 1.01]	1.33 [0.66, 2.69]	1.08 [0.56, 2.09]
High blood pressure (>140/90mmHg)	1.13* [1.02, 1.25]	1.24*** [1.13, 1.35]	1.07 [0.59, 1.94]	0.96 [0.59, 1.57]
Body Mass Index				
Lean (<25 kg/m2)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Overweight (25-30 kg/m2)	0.66*** [0.59, 0.74]	0.72*** [0.66, 0.79]	0.54 [0.28, 1.04]	1.60 [0.83, 3.11]
Obese (≥30 kg/m2)	0.68*** [0.60, 0.77]	0.64*** [0.56, 0.73]	0.68 [0.33, 1.41]	1.71 [0.83, 3.53]
Average physical activity per week				
Inactive	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
<1 Hour	0.70*** [0.60, 0.82]	0.70*** [0.61, 0.81]	1.33 [0.43, 4.15]	1.07 [0.45, 2.57]
1-2 hours	0.73*** [0.63, 0.83]	0.68*** [0.60, 0.77]	1.04 [0.34, 3.20]	0.87 [0.34, 2.18]
≥3 hours	0.81** [0.71, 0.93]	0.72*** [0.64, 0.82]	0.98 [0.31, 3.11]	1.44 [0.59, 3.51]
N	8343	8278	2251	2236

HR; hazard ratios, are based on cox proportional hazard models with repeated measures of alcohol consumption. All time-varying scores were updated in 2001, 2007-08, and 2015-16 for those who participated. All estimates are adjusted for education, age and including all listed covariates. End of follow-up on November 25, 2020.

Exponentiated coefficients; 95% confidence intervals in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a]In 1994-95, the seven-item CONOR Mental Health Index (CONOR-MHI) was used, whereas in the three subsequent surveys, the ten-item Hopkins Symptom Check List-10 (HSCL-10) was used [b]HII measures physical illness according to the impact that each condition has on SRH. [c]Subjects reporting the use of either or both sleeping pills/tranquilisers. In 1994-95, the time frame asked was "during the last *two* weeks", while in the three subsequent surveys it was "during the last *four* weeks". [c]Subjects reporting the use of either or both sleeping pills/tranquilisers. In 1994-95, the time frame asked was "during the last *two* weeks", while in the three subsequent surveys it was "during the last *four* weeks".

Appendix 1 – approval from REK

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK nord	Lill Martinsen		04.03.2020	96868
			Deres referanse:	

Ole Kristian Grønli

96868 Alkohol og aldring – en studie av alkoholvaner blant eldre og potensialet forhelseskade av alkohol

Forskningsansvarlig: Universitetssykehuset Nord-Norge HF

Søker: Ole Kristian Grønli

Søkers beskrivelse av formål:

Formålet med prosjektet er å bidra til økt kunnskap om endring av alkoholvaner blant eldre, samt undersøke helseeffekter av ulikt alkoholkonsum blant eldre 60 år. Videre vil vi finne variabler som er assosiert med høyt forbruk av alkohol (risikofaktorer) hos eldre i dagens kohorte av eldre.
Data til studien vil vi hente fra Tromsøundersøkelsene 4-7 (1995-2016). Data er allerede innhentet og samtykkeerklæringer fra deltakerne foreligger.
Vi vil benytte avanserte statistiske metoder (multilevel, mixed models, vekstkurver med gjentatte målinger) for å kunne besvare disse forskningsspørsmålene.
På bakgrunn av den store økningen av eldre mennesker fremover og økt alkoholforbruk som mulig risikofaktor for svekket helse, anses resultatene fra dette forskningsprosjektet å kunne få stor samfunnsmessig betydning. Økt kunnskap om risikofaktorer for høyt forbruk av alkohol blant eldre og mulige negative helseeffekter, anses å kunne brukes i det sykdomsforebyggende folkehelse arbeidet.

REKs vurdering

Vi viser til søknad om forhåndsgodkjenning av ovennevnte forskningsprosjekt. Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk REK nord i møtet 13.02.20. Vurderingen er gjort med hjemmel i helseforskningsloven § 10.

Om prosjektet
Prosjektet er en del av en ph.d.

Data/materiale
Data fra Tromsundersøkelsene 4-7 skal sammenstilles med data i Dødsårsaksregisteret.

Forespørsel/informasjon/samtykkeerklæring
Det skal benyttes data fra Tromsø 4-7. Det er innhentet samtykke for deltakere i Tromsø 4, 5, 6 og 7. Felles for disse er at de har mottatt informasjon om studien, samtykket til at innsamlede data kan brukes til medisinsk forskning, samt kobling mot ulike registre

REK vurderer at samtykkene som er innhentet i Tromsøundersøkelsene 4-7 er dekkende for det som skal gjøres i prosjektet.

Vedtak
Godkjent

REK har gjort en helhetlig forskningsetisk vurdering av alle prosjektets sider og godkjenner det med hjemmel i helseforskningsloven § 10.

Prosjektet er godkjent frem til omsøkt sluttdato 01.08.2023. Data skal oppbevares for kontrollhensyn i 5 år etter prosjektslutt. Etter dette skal data anonymiseres eller slettes.

Vi gjør samtidig oppmerksom på at etter personopplysningsloven må det også foreligge et behandlingsgrunnlag etter personvernforordningen. Dette må forankres i egen institusjon.

Med vennlig hilsen

May Britt Rossvoll sekretariatsleder

Sluttmelding
Søker skal sende sluttmelding til REK nord på eget skjema senest seks måneder etter godkjenningsperioden er utløpt, jf. hfl. § 12.

Søknad om å foreta vesentlige endringer
Dersom man ønsker å foreta vesentlige endringer i forhold til formål, metode, tidsløp eller organisering, skal søknad sendes til den regionale komiteen for medisinsk og helsefaglig forskningsetikk som har gitt forhåndsgodkjenning. Søknaden skal beskrive hvilke endringer som ønskes foretatt og begrunnelsen for disse, jf. hfl. § 11.

Appendix 2 - approval from FHI, The Norwegian Cause of Death Registry

Universitetssykehuset Nord Norge

v/ Ole Kristian Grønli

Deres ref.:	Vår ref.:	Dato:
	21/15163-2	06.10.2021

Vedtak om tilgjengeliggjøring av data fra Folkehelseinstituttet til prosjektet «Alkohol og aldring - en studie på alkoholvaner blant eldre og potensiale for helseskade av alkohol»

Det vises til søknad mottatt 23.08.2021 der det ble søkt om at allerede utleverte data fra Dødsårsaksregisteret til Tromsøundersøkelsen kan brukes i ovennevnte prosjekt.

Prosjektets behandlingsgrunnlag

Prosjektet har dokumentert lovlig grunnlag for behandling av data fra Dødsårsaksregisteret i samsvar med personvernforordningen artikkel 6 og 9 og reglene om taushetsplikt:

- Personvernforordningen (GDPR) artikkel 6 nr. 1 a
- Personvernforordningen (GDPR) artikkel 9 nr. 2 a

Det er innhentet samtykke fra studiepopulasjonen i dette prosjektet.

Prosjektet er medisinsk og helsefaglig forskning og har forhåndsgodkjenning fra REK, jf. helseforskningsloven § 10 (04.03.2020, ref.nr. 96868/REK Nord).

Folkehelseinstituttets vurdering av prosjektet

Folkehelseinstituttet har vurdert søknaden og funnet at prosjektet ligger innenfor formålet til Dødsårsaksregisteret og at øvrige vilkår for tilgjengeliggjøring av sammenstilte data er oppfylt, jf.:

- Helseregisterloven § 19 [a-e] samt forskrift om Dødsårsaksregisteret § 1-3

Ifølge helseregisterloven § 6 (jf. GDPR art. 5 nr. 1 c om «dataminimering») og helseforskningsloven § 32, skal den dataansvarlige sørge for at helseopplysningene som behandles er tilstrekkelige, relevante og begrenset til det som er nødvendig for formålet med behandlingen, og at graden av personidentifikasjon ikke er større enn nødvendig for det aktuelle formålet. Prosjektleder må derfor gjøre en grundig vurdering av hvilke variabler som er nødvendige for prosjektet og hvilken detaljeringsgrad disse i så fall må ha. Dette gjelder opplysninger fra alle datakilder som skal inngå i prosjektet.

Vedtak fra Folkehelseinstituttet

Folkehelseinstituttet har godkjent at allerede utleverte data fra Dødsårsaksregisteret til Tromsøundersøkelsen kan leveres til prosjektet på følgende vilkår:

- Det er kun variabelen dødsdato som kan leveres til prosjektet.
- Universitetssykehuset Nord Norge er ansvarlig for å sikre at all behandling av personopplysninger i prosjektet følger kravene i personopplysningsloven og GDPR. Dette inkluderer å vurdere om det er krav om å gjennomføre en personvernkonsekvensanalyse (DPIA) før behandlingen av personopplysninger starter.
- FHI forutsetter at Universitetssykehuset Nord Norge har vurdert at samtykket er innhentet i tråd med kravene i GDPR.
- Opplysningene skal kun brukes til formålet som er oppgitt i søknaden.
- Dersom personopplysninger skal overføres/tilgjengeliggjøres for medarbeidere ved institusjoner i tredjeland, må prosjektet oppfylle krav om nødvendige garantier, godkjent overføringsgrunnlag og tilleggstiltak, ref. EUs personvernforordning artikkel 46 og Schrems II-dommen. Dette gjelder også ved bruk av fjerntilgang (f.eks. TSD, HUNT Cloud eller lignende), se anbefalingene fra Det europeiske personvernrådet (EDPB): https://edpb.europa.eu/system/files/2021-06/edpb_recommendations_202001vo.2.0_supplementarymeasurestransferstools_en.pdf
- Det kan ikke overføres data til tredjeland med mindre det er benyttet et godkjent overføringsgrunnlag etter EUs personvernforordning artikkel 46. Det er forskningsansvarlig institusjon (dataansvarlig for prosjektet) som er ansvarlig for at det benyttes en godkjent overføringsmekanisme og tilstrekkelige tilleggstiltak. FHI ber derfor om at det opplyses om hvilke garantier, overføringsgrunnlag og tiltak som skal benyttes, og en bekreftelse på at disse er i tråd med retningslinjer hos den forskningsansvarlige (dataansvarlige) for prosjektet.
- Universitetssykehuset Nord Norge skal informere Folkehelseinstituttet ved vesentlige endringer i prosjektet, som f.eks. endring i dataansvarlig institusjon, prosjektleder eller prosjektvarighet.
- Datamaterialet kan oppbevares for kontrollformål i fem år etter prosjektslutt (01.08.2023) i henhold til godkjennelsen fra REK. Datamaterialet skal deretter slettes, senest 01.08.2028. Skriftlig bekreftelse på at materialet er slettet skal oversendes Folkehelseinstituttet.
- Ved publisering eller offentliggjøring skal Dødsårsaksregisteret ved Folkehelseinstituttet oppgis som kilde. I alle publikasjoner skal registerets offisielle navn eller forkortelse inngå i tittel eller abstracttekst av hensyn til PubMed-søk. For nærmere informasjon om registrenes offisielle navn og forkortelser, se https://www.fhi.no/div/datatilgang/retningslinje-for-referanse/
- Folkehelseinstituttet er ikke ansvarlig for tolkninger eller analyser av dataene som blir gjort av andre.
- På Folkehelseinstituttets nettsider vil det publiseres informasjon om at dette prosjektet har fått tilgang til data.

- Publisering og annen offentliggjøring skal gis i en slik form at enkeltpersoner ikke kan identifiseres.

Videre saksbehandling

Tromsøundersøkelsen kan levere dødsdato for aktuelle individer til prosjektet når prosjektet har mottatt dette vedtaket.

Fakturering

Vi gjør oppmerksom på at i henhold til helseregisterloven § 19 g kan helseregistrene ta betalt for faktiske utgifter i forbindelse med administrativt arbeid, tilrettelegging og tilgjengeliggjøring av data til prosjektet.

Klagegang

Dette er et enkeltvedtak som kan påklages etter forvaltningsloven kapittel VI. Klagefristen er tre uker etter at du har mottatt melding om vedtak. Rett klageinstans er Helse- og omsorgsdepartementet.

En eventuell klage sendes først Folkehelseinstituttet. Folkehelseinstituttet skal etter at klagen er mottatt, gjennomgå saken på ny og foreta de undersøkelser som klagen gir grunn til. Folkehelseinstituttet kan omgjøre vedtaket. Fastholdes vedtaket, sendes klagen videre til Helse- og omsorgsdepartementet for endelig avgjørelse.

Kontaktinformasjon

Ta kontakt ved spørsmål. Benytt e-post: daroppdrag@fhi.no.

Oppgi alltid saks- og prosjektnummer ved henvendelser.

Søknaden har fått tildelt prosjektnummer PDB 3107 og saksnummer 21/15163.

Vennlig hilsen

Maj-Lis Baldersheim
Avdelingsdirektør

Yngve Pedersen
Seniorrådgiver

Dokumentet er elektronisk godkjent av Baldersheim, Maj-Lis.

Appendix 3 - Questionnaires Tromsø4

HEALTH SURVEY
Invitation

Date of birth Social security No. Municipality Electoral ward No.

Welcome to the Tromsø Health Survey!

The Health Survey is coming to Tromsø. This leaflet will tell you when and where. You will also find information about the survey in the enclosed brochure.

We would like you to fill in the form overleaf and take it with you to the examination.

The more people take part in the survey, the more valuable its results will be. We hope, therefore, that you will be able to come. Attend even if you feel healthy, if you are currently receiving medical treatment, or if you have had your cholesterol and blood pressure measured recently.

Yours sincerely,
Municipal Health Authorities
Faculty of Medicine - University of Tromsø
National Health Screening Service

YOUR OWN HEALTH

What is your current state of health? *Tick one box only.*

Poor	12	1
Not so good		2
Good		3
Very good		4

Do you have, or have you had:

	Yes	No	Age first time
A heart attack 13			years
Angina pectoris (heart cramp) 16			years
A cerebral stroke/ brain haemorrhage 19			years
Asthma 22			years
Diabetes 25			years

Do you use blood pressure lowering drugs?

Currently	28	1
Previously, but not now		2
Never used		3

Have you during the last year suffered from pains and/or stiffness in muscles and joints that have lasted continuously for at least 3 months? 29 — Yes / No

Have you in the last two weeks felt:

	No	A little	A lot	Very much
Nervous or worried? 30				
Anxious? 31				
Confident and calm? 32				
Irritable? 33				
Happy and optimistic? 34				
Down/depressed? 35				
Lonely? 36				
	1	2	3	4

SMOKING

Did any of the adults at home smoke while you were growing up? 37 — Yes / No

Do you currently, or did you previously, live together with daily smokers after your 20th birthday? 38 — Yes / No

If "YES", for how many years in all? 39 — Years

How many hours a day do you normally spend in smoke-filled rooms? 41 — Hours

Put 0 if you do not spend time in smoke-filled rooms.

Do you yourself smoke:

	Yes	No
Cigarettes daily? 43		
Cigars/ cigarillos daily? 44		
A pipe daily? 45		

If you previously smoked daily, how long is it since you quit? 46 — Years

If you currently smoke, or have smoked previously:

How many cigarettes do you or did you usually smoke per day? 48 — cigarettes

How old were you when you began daily smoking? 52 — Age years

How many years in all have you smoked daily? 54 — Years

EXERCISE

How has your physical activity in leisure time been during this last year? *Think of your weekly average for the year.*

Time spent going to work counts as leisure time.

	Hours per week: None	Less than 1	1-2	3 or more
Light activity *(not sweating/out of breath)* 56				
Hard activity *(sweating/ out of breath)* 57				
	1	2	3	4

COFFEE

How many cups of coffee do you drink daily?

Put 0 if you do not drink coffee daily.

Coarsely ground coffee for brewing	58	Cups
Other coffee	60	Cups

ALCOHOL

Are you a teetotaller? 62 — Yes / No

How many times a month do you normally drink alcohol? *Do not count low-alcohol beer.*

Put 0 if less than once a month. 63 — Times

How many glasses of beer, wine or spirits do you normally drink in a fortnight? 65

Do not count low-alcohol beer.

Put 0 if less than once a month.

Beer	Wine	Spirits
Glasses	Glasses	Glasses

FAT

What type of margarine or butter do you usually use on bread? *Tick one box only.*

Don't use butter/margarine	71	1
Butter		2
Hard margarine		3
Soft margarine		4
Butter/margarine mixtures		5
Light margarine		6

EDUCATION/WORK

What is the highest level of education you have completed?

7-10 years primary/secondary school, modern secondary school	72	1
Technical school, middle school, vocational school, 1-2 years senior high school		2
High school diploma (3-4 years)		3
College/university, less than 4 years		4
College/university, 4 or more years		5

What is your current work situation?

Paid work	73	
Full-time housework	74	
Education, military service	75	
Unemployed, on leave without payment	76	

How many hours of paid work do you have per week? 77 — No. of hours

Do you receive any of the following benefits?

Sickness benefit (sick leave)	79	
Rehabilitation benefit	80	
Disability pension	81	
Old-age pension	82	
Social welfare benefit	83	
Unemployment benefit	84	

ILLNESS IN THE FAMILY

Have one or more of your parents or siblings had a heart attack or had angina (heart cramp)? 85 — Yes / No / Don't know

Tromsø Health Survey
for the over 70s

The main aim of the Tromsø Study is to improve our knowledge about cardiovascular diseases in order to aid prevention. The survey is also intended to improve our knowledge of cancer and other general conditions, such as allergies, muscle pains and mental conditions. Finally, the survey should give knowledge about the older part of the population. We would therefore like you to answer the questions below.

This form is a part of the Health Survey, which has been approved by the Norwegian Data Inspectorate and the Regional Board of Research Ethics. The answers will only be used for research purposes and will be treated in strict confidence. The information you give us may later be stored along with information from other public health registers in accordance with the rules laid down by the Data Inspectorate and the Regional Board of Research Ethics.

If you are in doubt about what to answer, tick the box that you feel fits best.

The completed form should be sent to us in the enclosed pre-paid envelope.

Thank you in advance for helping us.

Yours sincerely,

Faculty of Medicine
University of Tromsø

National Health Screening Service

If you do not wish to answer the questionnaire, tick the box below and return the form. Then you will not receive reminders.

I do not wish to answer the questionnaire ..... 17 ❑

Day Month Year

Date for filling in this form: ..... 18 ...../...../.....

CHILDHOOD/YOUTH

In which Norwegian municipality did you live at the age of 1year?

..... 24-28

If you did not live in Norway, give country instead of municipality

How was your family's financial situation during your childhood?

- Very good ..... 29 ❑ 1
- Good ..... ❑ 2
- Difficult ..... ❑ 3
- Very difficult ..... ❑ 4

How old were your parents when they died?

- Mother ..... 30 _____ Years
- Father ..... 32 _____ Years

HOME

Who do you live with?
Tick once for each item and give the number.

	Yes	No	Number
Spouse/partner 34	❑	❑	
Other people over 18 years 35	❑	❑	_____
People under 18 years 38	❑	❑	_____

What type of house do you live in?

- Villa/ detached house ..... 41 ❑ 1
- Farm ..... ❑ 2
- Flat/apartment ..... ❑ 3
- Terraced /semi-detached house ..... ❑ 4
- Other ..... ❑ 5

How long have you lived in your present home? ..... 42 _____ years

	Yes	No
Is your home adapted to your needs? 44	❑	❑
If "No", do you have problems with:		
Living space 45	❑	❑
Variable temperature, too cold/too warm 46	❑	❑
Stairs 47	❑	❑
Toilet 48	❑	❑
Bath/shower 49	❑	❑
Maintenance 50	❑	❑
Other (please specify) 51	❑	❑
Would you like to move into a retirement home? 52	❑	❑

PREVIOUS WORK AND FINANCIAL SITUATION

How will you describe the type of work you had for the last 5-10 years before you retired?

- Mostly sedentary work? ..... 53 ❑ 1
  (e.g. office work, mounting)
- Work that requires a lot of walking? ..... ❑ 2
  (e.g. shop assistant, housewife, teaching)
- Work that requires a lot of walking and lifting? ..... ❑ 3
  (e.g. postman, nurse, construction)
- Heavy manual work ..... ❑ 4
  (e.g. forestry, heavy farm-work, heavy construction)

Did you do any of the following jobs (full-time or part-time)?
Tick one box only for each item.

	Yes	No
Driver 54	❑	❑
Farmer 55	❑	❑
Fisherman 56	❑	❑

How old were you when you retired? ..... 57 _____ Years

What kind of pension do you have?

- Basic state pension ..... 59 ❑
- An additional pension ..... 60 ❑

How is your current financial situation?

- Very good ..... 61 ❑ 1
- Good ..... ❑ 2
- Difficult ..... ❑ 3
- Very difficult ..... ❑ 4

HEALTH AND ILLNESS

Has your state of health changed in the last year?

- Yes, it has got worse ... 62 ❑ 1
- No, unchanged ... ❑ 2
- Yes, it has got better ... ❑ 3

How do you feel your health is now compared to others of your age?

- Much worse ... 63 ❑ 1
- A little worse ... ❑ 2
- About the same ... ❑ 3
- A little better ... ❑ 4
- Much better ... ❑ 5

YOUR OWN ILLNESSES

Have you ever had:
Tick one box only for each item. Give your age at the time. If you have had the condition several times, how old were you last time?

		Yes	No	Age
Hip fracture	64	❑	❑	_____
Wrist /forearm fracture	67	❑	❑	_____
Whiplash	70	❑	❑	_____
Injury requiring hospital admission	73	❑	❑	_____
Gastric ulcer	76	❑	❑	_____
Duodenal ulcer	79	❑	❑	_____
Gastric/duodenal ulcer surgery	82	❑	❑	_____
Neck surgery	85	❑	❑	_____

Have you ever had, or do you have:
Tick one box only for each item.

		Yes	No
Cancer	88	❑	❑
Epilepsy		❑	❑
Migraine		❑	❑
Parkinson's disease		❑	❑
Chronic bronchitis		❑	❑
Psoriasis	93	❑	❑
Osteoporosis		❑	❑
Fibromyalgia/fibrositis/chronic pain syndrome		❑	❑
Psychological problems for which you have sought help		❑	❑
Thyroid disease		❑	❑
Liver disease	98	❑	❑
Recurrent urinary incontinence		❑	❑
Glaucoma		❑	❑
Cataract		❑	❑
Arthrosis (osteoarthritis)		❑	❑
Rheumatoid arthritis	103	❑	❑
Kidney stones		❑	❑
Appendectomy		❑	❑
Allergy and hypersensitivity			
Atopic eczema (e.g. childhood eczema)		❑	❑
Hand eczema		❑	❑
Hey fever	108	❑	❑
Food allergy		❑	❑
Other hypersensitivity (not allergy)		❑	❑

How many times have you had a common cold, influenza (flu), diarrhoea/vomiting or similar in the last 6 months? 111 ____ times

		Yes	No
Have you had this in the last 14 days?	113	❑	❑

ILLNESS IN THE FAMILY

Tick for the relatives who have or have ever had any of the following diseases:
Tick "None" if none of your relatives have had the disease.

		Mother	Father	Brother	Sister	Child	None
Cerebral stroke or brain haemorrhage	114	❑	❑	❑	❑	❑	❑
Heart attack before age 60	120	❑	❑	❑	❑	❑	❑
Cancer	126	❑	❑	❑	❑	❑	❑
Hypertension	132	❑	❑	❑	❑	❑	❑
Asthma	138	❑	❑	❑	❑	❑	❑
Osteoporosis	144	❑	❑	❑	❑	❑	❑
Arthrosis (osteoarthritis)	150	❑	❑	❑	❑	❑	❑
Psychological problems	156	❑	❑	❑	❑	❑	❑
Dementia	162	❑	❑	❑	❑	❑	❑
Diabetes	168	❑	❑	❑	❑	❑	❑
- age when they got diabetes	174	__	__	__	__	__	

SYMPTOMS

		Yes	No
Do you cough about daily for some periods of the year?	184	❑	❑
If "Yes":			
Is your cough productive?	185	❑	❑
Have you had this kind of cough for as long as 3 months in each of the last two years?	86	❑	❑
Have you had episodes with wheezing in your chest?	87	❑	❑
If "Yes", has this occurred:			
Tick one box only for each item.			
At night	188	❑	❑
In connection with respiratory infections		❑	❑
In connection with physical exertion		❑	❑
In connection with very cold weather	91	❑	❑
Have you noticed sudden changes in your pulse or heart rhythm in the last year?	92	❑	❑
Have you lost weight in the last year?	193	❑	❑
If "Yes":			
How many kilograms?	194	_____ kg	

How often do you suffer from sleeplessness?

- Never, or just a few times a year ... 196 ❑ 1
- 1-2 times a month ... ❑ 2
- Approximately once a week ... ❑ 3
- More than once a week ... ❑ 4

If you suffer from sleeplessness, what time of the year does it affect you most?

- No particular time of year ... 197 ❑ 1
- Especially during the polar night ... ❑ 2
- Especially during the midnight sun season ... ❑ 3
- Especially in spring and autumn ... ❑ 4

		Yes	No
Do you usually take a nap during the day?	198	❑	❑
Do you feel that you usually get enough sleep?		❑	❑

Do you suffer from:		No	A little	A lot
Dizziness	200	❑	❑	❑
Poor memory		❑	❑	❑
Lack of energy		❑	❑	❑
Constipation	203	❑	❑	❑

Does the thought of getting a serious illness ever worry you?

- Not at all ..... 204 ☐
- Only a little ..... ☐
- Some ..... ☐
- Very much ..... ☐

BODILY FUNCTIONS

Can you manage the following everyday activities on your own without help from others?	Yes	With some help	No
Walking indoors on one level 205	☐	☐	☐
Walking up/down stairs	☐	☐	☐
Walking outdoors	☐	☐	☐
Walking approx. 500 metres	☐	☐	☐
Going to the toilet	☐	☐	☐
Washing yourself 210	☐	☐	☐
Taking a bath/shower	☐	☐	☐
Dressing and undressing	☐	☐	☐
Getting in and out of bed	☐	☐	☐
Eating	☐	☐	☐
Cooking 215	☐	☐	☐
Doing light housework *(e.g. washing up)*	☐	☐	☐
Doing heavier housework *(e.g. cleaning floor)* ..	☐	☐	☐
Go shopping	☐	☐	☐
Take the bus	☐	☐	☐

	Yes	With difficulty	No
Can you hear normal speech (if necessary with hearing aid)? 220	☐	☐	☐
Can you read (if necessary with glasses)? 221	☐	☐	☐

Are you dependent on any of the following aids? ?

	Yes	No
Walking stick 222	☐	☐
Crutches	☐	☐
Walking frame/zimmer frame	☐	☐
Wheelchair	☐	☐
Hearing aid	☐	☐
Safety alarm device 227	☐	☐

USE OF HEALTH SERVICES

How many visits have you made during the past year due to your own health or illness:
Put 0 if you have not had such contact

	Number of times the past year
To a general practitioner (GP)/emergency GP 228	
To a psychologist or psychiatrist	
To an other medical specialist (not at a hospital)	
To a hospital out-patient clinic 234	
Admitted to a hospital	
To a physiotherapist	
To a chiropractor 240	
To a acupuncturist	
To a dentist	
To a chiropodist 246	
To an alternative practitioner (homoeopath, foot zone therapist, etc.)	
To a healer, faith healer, clairvoyant	

Do you have home aid?	Yes	No
Private 252	☐	☐
Municipal	☐	☐

Do you receive home nursing care? ..... ☐ ☐

Are you pleased with the health care and home assistance services in the municipality?

	Yes	No	Don't know
Assigned family GP 255	☐	☐	☐
Home nursing care	☐	☐	☐
Home assistance services	☐	☐	☐

Do you feel confident that you will receive health care and home assistance services if you need it?

- Confident ..... 258 ☐ 1
- Not confident ..... ☐ 2
- Very unsure ..... ☐ 3
- Don't know ..... ☐ 4

MEDICATION AND DIETARY SUPPLEMENTS

Have you for any length of time in the last year used any of the following medicines or dietary supplements daily or almost daily? Indicate how many months you have used them.
Put 0 for items you have not used.

Medicines:

- Painkillers ..... 259 _____ months
- Sleeping pills ..... _____ months
- Tranquillizers ..... _____ months
- Antidepressants ..... 265 _____ months
- Allergy drugs ..... _____ months
- Asthma drugs ..... _____ months
- Heart medicines (not blood pressure) ..... 271 _____ months
- Insulin ..... _____ months
- Diabetes tablets ..... _____ months
- Drugs for hypothyroidism (Thyroxine) ..... 277 _____ months
- Cortisone tablets ..... _____ months
- Remedies for constipation ..... _____ months

Dietary supplements:

- Iron tablets ..... 283 _____ months
- Vitamin D supplements ..... _____ months
- Other vitamin supplements ..... _____ months
- Calcium tablets or bone meal ..... 289 _____ months
- Cod liver oil or fish oil capsules ..... _____ months

FAMILY AND FRIENDS

Do you have close relatives who can give you help and support when you need it? 293	Yes ☐	No ☐
If "Yes", who can give you help?		
Spouse/partner 294	☐	
Children	☐	
Others	☐	

How many good friends do you have whom you can talk confidentially with and who give you help when you need it? ..... 297 ____ good friends
Do not count people you live with, but do include other relatives!

	Yes	No
Do you feel you have enough good friends? 299	☐	☐

Do you feel that you belong to a community (group of people) who can depend on each other and who feel committed to each other (e.g. a political party, religious group, relatives, neighbours, work place, or organisation)?

- Strong sense of belonging ..... 300 ☐ 1
- Some sense of belonging ..... ☐ 2
- Not sure ..... ☐ 3
- Little or no sense of belonging ..... ☐ 4

How often do you normally take part in organised gatherings, e.g. sewing circles, sports clubs, political meetings, religious or other associations?

- Never, or just a few times a year ..... 301 ❑ 1
- 1-2 times a month ..... ❑ 2
- Approximately once a week ..... ❑ 3
- More than once a week ..... ❑ 4

FOOD HABITS

	Number
How many meals a day do you normally eat (dinner and bread meals)? 302	_____
How many times a week do you eat warm dinner? 304	_____

What kind of bread (bought or home-made) do you usually eat?

Tick one or two boxes.

	White Bread	Light textured	Ordinary brown	Coarse brown	Crisp bread
The bread type is most similar to:	❑ 306	❑	❑	❑	❑ 310

What kind of fat is normally used in *cooking* (not on the bread) in your home?

- Butter ..... 311 ❑
- Hard margarine ..... ❑
- Soft margarine ..... ❑
- Butter/margarine blend ..... ❑
- Oils ..... 315 ❑

How much (in number of glasses, cups, potatoes or slices) do you usually eat/drink daily the following foodstuffs?

Tick one box for each foodstuff.

	None	Less than 1	1-2	3 or more
Milk of all types (glasses) 316	❑	❑	❑	❑
Orange juice (glasses)	❑	❑	❑	❑
Potatoes	❑	❑	❑	❑
Slices of bread in total (incl. crispbread)	❑	❑	❑	❑
Slices of bread with				
– fish (e.g. mackerel in tomato sauce)	❑	❑	❑	❑
– cheese *(e.g. Gouda/Norvegia)*	❑	❑	❑	❑
– smoked cod caviare 322	❑ 1	❑ 2	❑ 3	❑ 4

How many times per week do you normally eat the following foodstuffs?

Tick for all foodstuffs listed.

	Never	Less than 1	1	2 or more
Yoghurt 323	❑	❑	❑	❑
Boiled or fried egg	❑	❑	❑	❑
Breakfast cereal/oatmeal, etc.	❑	❑	❑	❑
Dinner with				
– unprocessed meat	❑	❑	❑	❑
– fatty fish (e.g. salmon/red-fish)	❑	❑	❑	❑
– lean fish (e.g. cod) 328	❑	❑	❑	❑
– vegetables (fresh or cooked)	❑	❑	❑	❑
Carrots (fresh or cooked)	❑	❑	❑	❑
Cauliflower/cabbage/broccoli	❑	❑	❑	❑
Apples/pears	❑	❑	❑	❑
Oranges, mandarins, etc. 333	❑ 1	❑ 2	❑ 3	❑ 4

WELL BEING

How content do you generally feel with growing old?

- Good ..... 334 ❑ 1
- Quite good ..... ❑ 2
- Up and down ..... ❑ 3
- Bad ..... ❑ 4

What is your view of the future?

- Bright ..... 335 ❑ 1
- Not too bad ..... ❑ 2
- Quite worried ..... ❑ 3
- Dark ..... ❑ 4

TO BE ANSWERED BY WOMEN ONLY

MENSTRUATION

How old were you when you started menstruating? ..... 336 _____ years

How old were you when you stopped menstruating? ..... 338 _____ years

PREGNANCY

How many children have you given birth to? ..... 340 _____ Children

If you have given birth, fill in for each child the year of birth and approximately how many months you breastfed the child. If you have given birth to more than 6 children, note their birth year and number of months you breastfed at the space provided below for comments.

Child	Year of birth:	Number of months breastfed:
1	342 _____	_____
2	346 _____	_____
3	_____	_____
4	_____	_____
5	358 _____	_____
6	_____	_____

	Yes	No
Have you during pregnancy had high blood pressure and/or proteinuria? 366	❑	❑

If "Yes", during which pregnancy?	Pregnancy: First	Later
High blood pressure 367	❑	❑
Proteinuria 369	❑	❑

ESTROGEN

Do you use, or have you ever used estrogen:

	Now	Previously	Never
Tablets or patches 371	❑	❑	❑
Cream or suppositories 372	❑	❑	❑

If you use estrogen, what brand do you currently use?

..... 373

Your comments:

Thank you for the help! Remember to mail the form today!

Tromsø Health Survey

Appendix 4 - Questionnaires Tromsø5

E

Helse-
undersøkelsen

Personlig innbydelse

Ikke skriv her:

E13 (Kommune) (Fylke) (Land) E15 (Merke)

E1. EGEN HELSE

Hvordan er helsen din nå? *(Sett bare ett kryss)*

Dårlig	Ikke helt god	God	Svært god
☐ 1	☐ 2	☐ 3	☐ 4

Har du, eller har du hatt?:

	JA	NEI	Alder første gang
Astma	☐	☐	
Kronisk bronkitt/emfysem	☐	☐	
Diabetes (sukkersyke)	☐	☐	
Benskjørhet (osteoporose)	☐	☐	
Fibromyalgi/kronisk smertesyndrom	☐	☐	
Psykiske plager som du har søkt hjelp for	☐	☐	
Hjerteinfarkt	☐	☐	
Angina pectoris (hjertekrampe)	☐	☐	
Hjerneslag/hjerneblødning	☐	☐	

Får du smerter eller ubehag i brystet når du:	JA	NEI
Går i bakker, trapper eller fort på flat mark?	☐	☐

Hvis du får slike smerter, pleier du da å:

Stoppe?	Saktne farten?	Fortsette i samme takt?
☐ 1	☐ 2	☐ 3

	JA	NEI
Dersom du stopper, forsvinner smertene da etter mindre enn 10 minutter?	☐	☐
Kan slike smerter opptre selv om du er i ro?	☐	☐

E2. SYKDOM I FAMILIEN

Har en eller flere av dine foreldre eller søsken hatt:

	JA	NEI	Vet ikke
Hjerteinfarkt (sår på hjertet) eller angina pectoris (hjertekrampe)?	☐	☐	☐

Kryss av for de slektningene som har eller har hatt noen av sykdommene: *(Sett kryss for hver linje)*

	Mor	Far	Bror	Søster	Barn	Ingen av disse
Hjerneslag eller hjerneblødning	☐	☐	☐	☐	☐	☐
Hjerteinfarkt før 60 års alder	☐	☐	☐	☐	☐	☐
Astma	☐	☐	☐	☐	☐	☐
Kreftsykdom	☐	☐	☐	☐	☐	☐
Diabetes (sukkersyke)	☐	☐	☐	☐	☐	☐

Hvis noen slektninger har diabetes, i hvilken alder fikk de diabetes (hvis for eks. flere søsken, før opp den som fikk det tidligst i livet):

Vet ikke, ikke aktuelt	Mors alder	Fars alder	Brors alder	Søsters alder	Barns alder
☐					

E3. PLAGER

Under finner du en liste over ulike problemer. Har du opplevd noe av dette den siste uken (til og med i dag)? *(Sett ett kryss for hver linje)*

	Ikke plaget	Litt plaget	Ganske mye	Veldig mye
Plutselig frykt uten grunn	☐	☐	☐	☐
Føler deg redd eller engstelig	☐	☐	☐	☐
Matthet eller svimmelhet	☐	☐	☐	☐
Føler deg anspent eller oppjaget	☐	☐	☐	☐
Lett for å klandre deg selv	☐	☐	☐	☐
Søvnproblemer	☐	☐	☐	☐
Nedtrykt, tungsindig	☐	☐	☐	☐
Følelse av å være unyttig, lite verd	☐	☐	☐	☐
Følelse av at alt er et slit	☐	☐	☐	☐
Følelse av håpløshet mht. framtida	☐ 1	☐ 2	☐ 3	☐ 4

E4. TENNER, MUSKEL OG SKJELETT

Hvor mange tenner har du mistet/trukket? *Antall tenner*
(Se bort fra melketenner og visdomstenner)

Har du vært plaget med smerter og/eller stivhet i muskler og ledd i løpet av de siste 4 ukene?

	Ikke plaget	En del plaget	Alvorlig plaget
Nakke/skuldre	☐	☐	☐
Armer, hender	☐	☐	☐
Øvre del av ryggen	☐	☐	☐
Korsryggen	☐	☐	☐
Hofter, ben, føtter	☐	☐	☐
Andre steder	☐	☐	☐

Har du noen gang hatt:	JA	NEI	Alder siste gang
Brudd i håndledd/underarm?	☐	☐	
Lårhalsbrudd?	☐	☐	

Har du falt i løpet av det siste året? *(Sett bare ett kryss)*

Nei	Ja, 1-2 ganger	Ja, mer enn 2 ganger
☐ 1	☐ 2	☐ 3

E5. MOSJON OG FYSISK AKTIVITET

Hvordan har din fysiske aktivitet vært det siste året?
Tenk deg et ukentlig gjennomsnitt for året.
Besvar begge spørsmålene.

	Timer pr. uke: Ingen	Under 1	1-2	3 og mer
Lett aktivitet *(ikke svett/andpusten)*	☐	☐	☐	☐
Hard fysisk aktivitet *(svett/andpusten)*	☐ 1	☐ 2	☐ 3	☐ 4

E6. VEKT

Anslå din vekt da du var 25 år gammel: ____ **hele kg**

E7. UTDANNING

Hvor mange års skolegang har du gjennomført? *Antall år*
(Ta med alle år du har gått på skole eller studert)

E8. MAT OG DRIKKE

Hvor ofte spiser du vanligvis disse matvarene?
(Sett ett kryss for hver linje)

	Sjelden /aldri	1-3 g. pr.mnd	1-3 g. pr.uke	4-6 g. pr.uke	1-2 g. pr.dag	3 g. el. mer pr.dag
Frukt, bær	☐	☐	☐	☐	☐	☐
Ost *(alle typer)*	☐	☐	☐	☐	☐	☐
Poteter	☐	☐	☐	☐	☐	☐
Kokte grønnsaker	☐	☐	☐	☐	☐	☐
Rå grønnsaker/salat	☐	☐	☐	☐	☐	☐
Feit fisk *(f.eks. laks, ørret, makrell, sild)*	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6

Bruker du kosttilskudd:

	Ja, daglig	Iblant	Nei
Tran, trankapsler, fiskeoljekapsler	☐	☐	☐
Vitamin- og/eller mineraltilskudd	☐	☐	☐

Hvor mye drikker du vanligvis av følgende?
(Sett ett kryss for hver linje)

	Sjelden /aldri	1-6 glass pr.uke	1 glass pr.dag	2-3 glass pr.dag	4 glass el. mer pr.dag
Helmelk, kefir, yoghurt	☐	☐	☐	☐	☐
Lettmelk, cultura, lettyoghurt	☐	☐	☐	☐	☐
Skummet melk (sur/søt)	☐	☐	☐	☐	☐
Ekstra lettmelk	☐	☐	☐	☐	☐
Fruktjuice	☐	☐	☐	☐	☐
Vann	☐	☐	☐	☐	☐
Brus, mineralvann	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Hvor mange kopper kaffe og te drikker du daglig?
(Sett 0 for de typene du ikke drikker daglig) *Antall kopper*

Filterkaffe

Kokekaffe/trykkanne

Annen kaffe

Te

Omtrent hvor ofte har du i løpet av det siste året drukket alkohol? *(Lettøl og alkoholfritt øl regnes ikke med)*

Har aldri drukket alkohol ☐ 1	Har ikke drukket alkohol siste år ☐ 2	Noen få ganger siste år ☐ 3	Omtrent 1 gang i måneden ☐ 4
2-3 ganger pr. måned ☐ 5	ca. 1 gang i uka ☐ 6	2-3 ganger i uka ☐ 7	4-7 ganger i uka ☐ 8

Til dem som har drukket siste år:

Når du har drukket alkohol, hvor mange glass eller drinker har du vanligvis drukket? *Antall*

Omtrent hvor mange ganger i løpet av det siste året har du drukket så mye som minst 5 glass eller drinker i løpet av ett døgn? *Antall ganger*

E9. RØYKING

Hvor lenge er du vanligvis daglig tilstede i et røykfylt rom? *Antall hele timer*

Røykte noen av de voksne hjemme da du vokste opp? JA ☐ NEI ☐

Bor du, eller har du bodd, sammen med noen dagligrøykere etter at du fylte 20 år? JA ☐ NEI ☐

Har du røykt/røyker du daglig? Ja, nå ☐ Ja, tidligere ☐ Aldri ☐

Hvis du ALDRI har røykt daglig;
Hopp til spørsmål E11 (FUNKSJON OG TRYGGHET)

Hvis du røyker daglig nå, røyker du:

	JA	NEI
Sigaretter?	☐	☐
Sigarer/sigarillos?	☐	☐
Pipe?	☐	☐

Hvis du har røykt daglig tidligere, hvor lenge er det siden du sluttet? *Antall år*

Hvis du røyker daglig nå eller har røykt tidligere:

Hvor mange sigaretter røyker eller røykte du vanligvis daglig? *Antall sigaretter*

Hvor gammel var du da du begynte å røyke daglig? *Alder i år*

Hvor mange år til sammen har du røykt daglig? *Antall år*

E10. FUNKSJON OG TRYGGHET

Ville du følt deg trygg ved å ferdes alene på kveldstid i nærområdet der du bor?

Ja	Litt utrygg	Svært utrygg
☐ 1	☐ 2	☐ 3

Når det gjelder førlighet, syn og hørsel, kan du:
(Sett ett kryss for hver linje)

	Uten problemer	Med litt problemer	Med store problemer	Nei
Gå en 5 minutters tur i noenlunde raskt tempo?	☐	☐	☐	☐
Lese vanlig tekst i aviser, evt. med briller?	☐	☐	☐	☐
Høre hva som blir sagt i en normal samtale?	☐ 1	☐ 2	☐ 3	☐ 4

Har du på grunn av varige helseproblemer vansker med å: *(Sett ett kryss for hver linje)*

	Ingen vansker	Noen vansker	Store vansker
Bevege deg rundt i egen bolig?	☐	☐	☐
Komme deg ut av boligen på egen hånd?	☐	☐	☐
Delta i foreningsliv eller andre fritidsaktiviteter?	☐	☐	☐
Bruke offentlige transportmidler?	☐	☐	☐
Utføre nødvendige daglige ærend?	☐	☐	☐

E11. BRUK AV HELSETJENESTER

Hvor mange ganger de siste 12 månedene har du selv brukt:
(Sett ett kryss for hver linje)

	Ingen	1-3 ganger	4 eller flere
Allmennpraktiserende lege	☐	☐	☐
Spesialist *(privat eller på poliklinikk)*	☐	☐	☐
Legevakt *(privat eller offentlig)*	☐	☐	☐
Sykehusinnleggelse	☐	☐	☐
Hjemmesykepleie	☐	☐	☐
Fysioterapeut	☐	☐	☐
Kiropraktor	☐	☐	☐
Kommunal hjemmehjelp	☐	☐	☐
Tannlege	☐	☐	☐
Alternativ behandler	☐	☐	☐

Er du trygg på at du kan få hjelp av helseog hjemmetjenesten hvis du trenger det?

JA	NEI	Vet ikke
☐ 1	☐ 2	☐ 3

E12. FAMILIE OG VENNER

Bor du: Hjemme? ☐ 1 Institusjon/bofellesskap? ☐ 2

Bor du sammen med:

	JA	NEI
Ektefelle/samboer?	☐	☐
Andre personer?	☐	☐

Hvor mange gode venner har du?
Regn med de du kan snakke fortrolig med og som kan gi deg hjelp når du trenger det. Tell ikke med de du bor sammen med, men ta med barn og andre slektninger.
Antall venner ☐☐

Hvor stor interesse viser folk for det du gjør?
(Sett bare ett kryss)

Stor interesse	Noe interesse	Litt interesse	Ingen interesse	Usikkert
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Hvor mange foreninger, lag, grupper, kirkesamfunn e.l. deltar du i ?
(Skriv 0 hvis ingen)
Antall ☐☐

E13. OPPVEKST OG TILHØRIGHET

Hvor lenge har du samlet bodd i fylket? ☐☐ år

Hvor lenge har du samlet bodd i kommunen? ☐☐ år

Hvor bodde du det meste av tiden før du fylte 16 år?
(Kryss av for ett alternativ og spesifiser)

Samme kommune ☐ 1

Annen kommune i fylket ☐ 2 Hvilken: _____

Annet fylke i Norge ☐ 3 Hvilket: _____

Utenfor Norge ☐ 4 Land: _____

Har du flyttet i løpet av de siste fem årene?

Nei	Ja, en gang	Ja, flere ganger
☐ 1	☐ 2	☐ 3

E14. BRUK AV MEDISINER

Med medisiner mener vi her medisiner kjøpt på apotek. Kosttilskudd og vitaminer regnes ikke med her.

Bruker du?
(Sett ett kryss for hver linje)

	Nå	Før, men ikke nå	Aldri brukt
Medisin mot høyt blodtrykk	☐	☐	☐
Kolesterolsenkende medisin	☐	☐	☐
Medisin mot osteoporose (benskjørhet)	☐	☐	☐
Insulin	☐	☐	☐
Tabletter mot sukkersyke	☐	☐	☐

Hvor ofte har du i løpet av de siste 4 ukene brukt følgende medisiner?
(Sett ett kryss for hver linje)

	Ikke brukt siste 4 uker	Sjeldnere enn hver uke	Hver uke, men ikke daglig	Daglig
Smertestillende uten resept	☐	☐	☐	☐
Smertestillende på resept	☐	☐	☐	☐
Sovemedisin	☐	☐	☐	☐
Beroligende medisin	☐	☐	☐	☐
Medisin mot depresjon	☐	☐	☐	☐
Annen medisin på resept	☐	☐	☐	☐
	1	2	3	4

Angi navnet på de medisinene du bruker nå, og hva grunnen er til at du tar medisinene (sykdom eller symptom):
(Kryss av for hvor lenge du har brukt medisinen)

Navn på medisinen: (ett navn pr. linje):	Grunn til bruk av medisinen:	Hvor lenge har du brukt medisinen? Inntil 1 år	Ett år eller mer
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐

Dersom det ikke er nok plass her, kan du fortsette på eget ark som du legger ved.

E15. RESTEN AV SKJEMAET SKAL BARE BESVARES AV KVINNER

Hvor gammel var du da du fikk menstruasjon aller første gang? *Alder i år* ☐☐

Hvor gammel var du da menstruasjonen sluttet? *Alder i år* ☐☐

Hvor mange barn har du født? *Antall barn* ☐☐

Bruker du, eller har du brukt østrogenmedisin? *I antall år totalt*

	Aldri	Før	Nå	
Tabletter eller plaster	☐	☐	☐	☐☐
Krem eller stikkpiller	☐	☐	☐	☐☐

Hvis du bruker østrogen; hvilket merke bruker du nå?

_____

	JA	NEI
Har du noen gang brukt P-pille?	☐	☐

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Appendix 5 - Questionnaires Tromsø6

Tromsø-undersøkelsen

Skjemaet skal leses optisk. Vennligst bruk blå eller sort penn. Du kan ikke bruke komma, bruk blokkbokstaver.

2007 – 2008 KONFIDENSIELT

HELSE OG SYKDOMMER

1 **Hvordan vurderer du din egen helse sånn i alminnelighet?**

- ☐ Meget god
- ☐ God
- ☐ Verken god eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

2 **Hvordan synes du at helsen din er sammenlignet med andre på din alder?**

- ☐ Mye bedre
- ☐ Litt bedre
- ☐ Omtrent lik
- ☐ Litt dårligere
- ☐ Mye dårligere

3 **Har du eller har du hatt?**

	Ja	Nei	Alder første gang
Hjerteinfarkt	☐	☐	
Angina pectoris *(hjertekrampe)*	☐	☐	
Hjerneslag/hjerneblødning	☐	☐	
Hjerteflimmer *(atrieflimmer)*	☐	☐	
Høyt blodtrykk	☐	☐	
Beinskjørhet *(osteoporose)*	☐	☐	
Astma	☐	☐	
Kronisk bronkitt/emfysem/KOLS	☐	☐	
Diabetes	☐	☐	
Psykiske plager *(som du har søkt hjelp for)*	☐	☐	
Lavt stoffskifte	☐	☐	
Nyresykdom, unntatt urinveisinfeksjon	☐	☐	
Migrene	☐	☐	

4 **Har du langvarige eller stadig tilbakevendende smerter som har vart i 3 måneder eller mer?**

☐ Ja ☐ Nei

5 **Hvor ofte har du vært plaget av søvnløshet de siste 12 måneder?**

- ☐ Aldri, eller noen få ganger
- ☐ 1-3 ganger i måneden
- ☐ Omtrent 1 gang i uken
- ☐ Mer enn 1 gang i uken

6 **Under finner du en liste over ulike problemer. Har du opplevd noe av dette den siste uken (til og med i dag)?** (Sett ett kryss for hver plage)

	Ikke plaget	Litt plaget	Ganske mye	Veldig mye
Plutselig frykt uten grunn	☐	☐	☐	☐
Føler deg redd eller engstelig	☐	☐	☐	☐
Matthet eller svimmelhet	☐	☐	☐	☐
Føler deg anspent eller oppjaget	☐	☐	☐	☐
Lett for å klandre deg selv	☐	☐	☐	☐
Søvnproblemer	☐	☐	☐	☐
Nedtrykt, tungsindig	☐	☐	☐	☐
Følelse av å være unyttig, lite verd	☐	☐	☐	☐
Følelse av at alt er et slit	☐	☐	☐	☐
Følelse av håpløshet mht. framtida	☐	☐	☐	☐

BRUK AV HELSETJENESTER

7 **Har du i løpet av de siste 12 måneder vært hos:** Hvis JA; Hvor mange ganger?

	Ja	Nei	Ant ggr
Fastlege/allmennlege	☐	☐	
Psykiater/psykolog	☐	☐	
Legespesialist utenfor sykehus *(utenom fastlege/allmennlege/psykiater)*	☐	☐	
Fysioterapeut	☐	☐	
Kiropraktor	☐	☐	
Annen behandler *(homøopat, akupunktør, fotsoneterapeut, naturmedisiner, håndspålegger, healer, synsk el.l)*	☐	☐	
Tannlege/tannpleier	☐	☐	

8 **Har du i løpet av de siste 12 måneder vært på sykehus?**

	Ja	Nei	Ant ggr
Innlagt på sykehus	☐	☐	
Konsultasjon ved sykehus uten innleggelse;			
Ved psykiatrisk poliklinikk	☐	☐	
Ved annen sykehuspoliklinikk	☐	☐	

9 **Har du gjennomgått noen form for operasjon i løpet av de siste 3 årene?**

☐ Ja ☐ Nei

BRUK AV MEDISINER

10 **Bruker du, eller har du brukt, noen av følgende medisiner?** (Sett ett kryss for hver linje)

	Aldri brukt	Nå	Før	Alder første gang
Medisin mot høyt blodtrykk	☐	☐	☐	
Kolesterolsenkende medisin	☐	☐	☐	
Medisin mot hjertesykdom	☐	☐	☐	
Vanndrivende medisin	☐	☐	☐	
Medisin mot beinskjørhet *(osteoporose)*	☐	☐	☐	
Insulin	☐	☐	☐	
Diabetesmedisin *(tabletter)*	☐	☐	☐	
Stoffskiftemedisinene Thyroxin/levaxin	☐	☐	☐	

11 **Hvor ofte har du i løpet av de siste 4 ukene brukt følgende medisiner?** (Sett ett kryss pr linje)

	Ikke brukt siste 4 uker	Sjeldnere enn hver uke	Hver uke, men ikke daglig	Daglig
Smertestillende på resept	☐	☐	☐	☐
Smertestillende reseptfrie	☐	☐	☐	☐
Sovemidler	☐	☐	☐	☐
Beroligende medisiner	☐	☐	☐	☐
Medisin mot depresjon	☐	☐	☐	☐

12 **Skriv ned alle medisiner – både de med og uten resept – som du har brukt regelmessig i siste 4 ukers periode.** (Ikke regn med vitaminer, mineraler, urter, naturmedisin, andre kosttilskudd etc.)

Får du ikke plass til alle medisiner, bruk eget ark.

VED FRAMMØTE vil du bli spurt om du har brukt antibiotika eller smertestillende medisiner de siste 24 timene. Om du har det, vil vi be om at du oppgir preparat, styrke, dose og tidspunkt

FAMILIE OG VENNER

13 **Hvem bor du sammen med?** (Sett kryss for hvert spørsmål og angi antall)

	Ja	Nei	Antall
Ektefelle/samboer	☐	☐	
Andre personer over 18 år	☐	☐	
Personer under 18 år	☐	☐	

14 **Kryss av for de slektninger som har eller har hatt**

	Foreldre	Barn	Søsken
Hjerteinfarkt	☐	☐	☐
Hjerteinfarkt før fylte 60 år	☐	☐	☐
Angina pectoris *(hjertekrampe)*	☐	☐	☐
Hjerneslag/hjerneblødning	☐	☐	☐
Beinskjørhet *(osteoporose)*	☐	☐	☐
Magesår/tolvfingertarmsår	☐	☐	☐
Astma	☐	☐	☐
Diabetes	☐	☐	☐
Demens	☐	☐	☐
Psykiske plager	☐	☐	☐
Rusproblemer	☐	☐	☐

15 **Har du nok venner som kan gi deg hjelp når du trenger det?**

☐ Ja ☐ Nei

16 **Har du nok venner som du kan snakke fortrolig med?**

☐ Ja ☐ Nei

17 **Hvor ofte tar du vanligvis del i foreningsvirksomhet som for eksempel syklubb, idrettslag, politiske lag, religiøse eller andre foreninger?**

☐ Aldri, eller noen få ganger i året
☐ 1-2 ganger i måneden
☐ Omtrent 1 gang i uken
☐ Mer enn en gang i uken

ARBEID, TRYGD OG INNTEKT

18 **Hva er din høyeste fullførte utdanning?** (Sett ett kryss)

☐ Grunnskole, framhaldsskole eller folkehøyskole
☐ Yrkesfaglig videregående, yrkesskole eller realskole
☐ Allmennfaglig videregående skole eller gymnas
☐ Høyskole eller universitet, mindre enn 4 år
☐ Høyskole eller universitet, 4 år eller mer

19 **Hva er din hovedaktivitet?** (Sett ett kryss)

☐ Yrkesaktiv heltid
☐ Yrkesaktiv deltid
☐ Arbeidsledig
☐ Hjemmeværende
☐ Pensjonist/trygdet
☐ Student/militærtjeneste

20 **Mottar du noen av følgende ytelser?**

- ☐ Alderstrygd, førtidspensjon (AFP) eller etterlattepensjon
- ☐ Sykepenger (er sykemeldt)
- ☐ Rehabiliterings-/attføringspenger
- ☐ Uføreytelse/pensjon, hel
- ☐ Uføreytelse/pensjon, delvis
- ☐ Dagpenger under arbeidsledighet
- ☐ Overgangstønad
- ☐ Sosialhjelp/-stønad

21 **Hvor høy var husholdningens samlede bruttoinntekt siste år?** Ta med alle inntekter fra arbeid, trygder, sosialhjelp og lignende.

- ☐ Under 125 000 kr
- ☐ 125 000-200 000 kr
- ☐ 201 000-300 000 kr
- ☐ 301 000-400 000 kr
- ☐ 401 000-550 000 kr
- ☐ 551 000-700 000 kr
- ☐ 701 000 -850 000 kr
- ☐ Over 850 000 kr

22 **Arbeider du utendørs minst 25 % av tiden, eller i lokaler med lav temperatur, som for eksempel lager-/industrihaller?**

- ☐ Ja
- ☐ Nei

FYSISK AKTIVITET

23 **Hvis du er i lønnet eller ulønnet arbeid, hvordan vil du beskrive arbeidet ditt?**

- ☐ For det meste stillesittende arbeid *(f.eks. skrivebordsarbeid, montering)*
- ☐ Arbeid som krever at du går mye *(f.eks ekspeditørarbeid, lett industriarbeid, undervisning)*
- ☐ Arbeid der du går og løfter mye *(f.eks postbud, pleier, bygningsarbeider)*
- ☐ Tungt kroppsarbeid

24 **Angi bevegelse og kroppslig anstrengelse i din fritid. Hvis aktiviteten varierer meget f eks mellom sommer og vinter, så ta et gjennomsnitt. Spørsmålet gjelder bare det siste året.** (Sett kryss i den ruta som passer best)

- ☐ Leser, ser på fjernsyn eller annen stillesittende beskjeftigelse
- ☐ Spaserer, sykler eller beveger deg på annen måte minst 4 timer i uken *(her skal du også regne med gang eller sykling til arbeidsstedet, søndagsturer med mer)*
- ☐ Driver mosjonsidrett, tyngre hagearbeid, snømåking e.l. *(merk at aktiviteten skal vare minst 4 timer i uka)*
- ☐ Trener hardt eller driver konkurranseidrett regelmessig og flere ganger i uka

25 **Hvor ofte driver du mosjon?** (Med mosjon mener vi at du f.eks går en tur, går på ski, svømmer eller driver trening/idrett)

- ☐ Aldri
- ☐ Sjeldnere enn en gang i uken
- ☐ En gang i uken
- ☐ 2-3 ganger i uken
- ☐ omtrent hver dag

26 **Hvor hardt mosjonerer du da i gjennomsnitt?**

- ☐ Tar det rolig uten å bli andpusten eller svett.
- ☐ Tar det så hardt at jeg blir andpusten og svett
- ☐ Tar meg nesten helt ut

27 **Hvor lenge holder du på hver gang i gjennomsnitt ?**

- ☐ Mindre enn 15 minutter
- ☐ 15-29 minutter
- ☐ 30 minutter – 1 time
- ☐ Mer enn 1 time

ALKOHOL OG TOBAKK

28 **Hvor ofte drikker du alkohol?**

- ☐ Aldri
- ☐ Månedlig eller sjeldnere
- ☐ 2-4 ganger hver måned
- ☐ 2-3 ganger pr. uke
- ☐ 4 eller flere ganger pr.uke

29 **Hvor mange enheter alkohol** (en øl, et glass vin, eller en drink) **tar du vanligvis når du drikker?**

- ☐ 1-2
- ☐ 3-4
- ☐ 5-6
- ☐ 7-9
- ☐ 10 eller flere

30 **Hvor ofte drikker du 6 eller flere enheter alkohol ved en anledning?**

- ☐ aldri
- ☐ sjeldnere enn månedlig
- ☐ månedlig
- ☐ ukentlig
- ☐ daglig eller nesten daglig

31 **Røyker du av og til, men ikke daglig?**

- ☐ Ja
- ☐ Nei

32 **Har du røykt/røyker du daglig?**

- ☐ Ja, nå
- ☐ Ja, tidligere
- ☐ Aldri

33 **Hvis du har røykt daglig tidligere, hvor lenge er det siden du sluttet?**

Antall år ☐☐

34 **Hvis du røyker daglig nå eller har røykt tidligere: Hvor mange sigaretter røyker eller røykte du vanligvis daglig?**

Antall sigaretter ☐☐

35 **Hvor gammel var du da du begynte å røyke daglig?**

Antall år ☐☐

36 **Hvor mange år til sammen har du røykt daglig?**

Antall år ☐☐

37 **Bruker du, eller har du brukt, snus eller skrå?**

- ☐ Nei, aldri
- ☐ Ja, men jeg har sluttet
- ☐ Ja, av og til
- ☐ Ja, daglig

KOSTHOLD

38 **Spiser du vanligvis frokost hver dag?**

☐ Ja ☐ Nei

39 **Hvor mange enheter frukt og grønnsaker spiser du i gjennomsnitt per dag?** (Med enhet menes f.eks. en frukt, glass juice, potet, porsjon grønnsaker)

Antall enheter ☐☐

40 **Hvor mange ganger i uken spiser du varm middag?**

Antall ☐☐

41 **Hvor ofte spiser du vanligvis disse matvarene?**
(Sett ett kryss pr linje)

	0-1 g pr. mnd	2-3 g pr.mnd	1-3 g pr.uke	4-6 g pr.uke	1-2 g pr. dag
Poteter	☐	☐	☐	☐	☐
Pasta/ris	☐	☐	☐	☐	☐
Kjøtt *(ikke kvernet)*	☐	☐	☐	☐	☐
Kvernet kjøtt *(pølser, hamburger o.l)*	☐	☐	☐	☐	☐
Grønnsaker, frukt, bær	☐	☐	☐	☐	☐
Mager fisk	☐	☐	☐	☐	☐
Feit fisk *(f.eks.laks, ørret, makrell, sild, kveite,uer)*	☐	☐	☐	☐	☐

42 **Hvor mye drikker du vanligvis av følgende?**
(Sett ett kryss pr. linje)

	Sjelden/ aldri	1-6 glass pr. uke	1 glass pr. dag	2-3 glass pr. dag	4 glass el. mer pr. dag
Melk, kefir, yoghurt	☐	☐	☐	☐	☐
Fruktjuice	☐	☐	☐	☐	☐
Brus/leskedrikker med sukker	☐	☐	☐	☐	☐

43 **Hvor mange kopper kaffe og te drikker du daglig?**
(sett 0 for de typene du ikke drikker daglig)

	Antall kopper
Filterkaffe	☐☐
Kokekaffe/presskanne	☐☐
Annen kaffe	☐☐
Te	☐☐

44 **Hvor ofte spiser du vanligvis fiskelever?**
(For eksempel i mølje)

☐ Sjelden/aldri ☐ 1-3 g i året ☐ 4-6 g i året
☐ 7-12 g i året ☐ Oftere

45 **Bruker du følgende kosttilskudd?**

	Daglig	Iblant	Nei
Tran, trankapsler	☐	☐	☐
Omega 3 kapsler *(fiskeolje,selolje)*	☐	☐	☐
Kalktabletter	☐	☐	☐

SPØRSMÅL TIL KVINNER

46 **Er du gravid nå?**

☐ Ja ☐ Nei ☐ Usikker

47 **Hvor mange barn har du født?**

Antall ☐☐

48 **Hvis du har født, fyll ut for hvert barn: fødselsår og vekt samt hvor mange måneder du ammet.**
(Angi så godt som du kan)

Barn	Fødselsår	Fødselsvekt i gram	Ammet ant.mnd
1	☐☐☐☐	☐☐☐☐	☐☐
2	☐☐☐☐	☐☐☐☐	☐☐
3	☐☐☐☐	☐☐☐☐	☐☐
4	☐☐☐☐	☐☐☐☐	☐☐
5	☐☐☐☐	☐☐☐☐	☐☐
6	☐☐☐☐	☐☐☐☐	☐☐

49 **Har du i forbindelse med svangerskap hatt for høyt blodtrykk?**

☐ Ja ☐ Nei

50 **Hvis Ja, i hvilket svangerskap?**

☐ Første ☐ Senere

51 **Har du i forbindelse med svangerskap hatt protein (eggehvite) i urinen?**

☐ Ja ☐ Nei

52 **Hvis Ja, i hvilket svangerskap?**

☐ Første ☐ Senere

53 **Ble noen av disse barna født mer enn en måned for tidlig (før termin) pga. svangerskapsforgiftning?**

☐ Ja ☐ Nei

54 **Hvis Ja, hvilke(t) barn**

Barn 1	Barn 2	Barn 3	Barn 4	Barn 5	Barn 6
☐	☐	☐	☐	☐	☐

55 **Hvor gammel var du da du fikk menstruasjon første gang?**

Antall år ☐☐

56 **Bruker du for tiden reseptpliktige legemidler som påvirker menstruasjonen?**

P-pille, hormonspiral eller lignende ☐ Ja ☐ Nei
Hormonpreparat for overgangs-alderen ☐ Ja ☐ Nei

VED FRAMMØTE vil du få utfyllende spørsmål om menstruasjon og eventuell bruk av hormoner. Skriv gjerne ned på et papir navn på hormonpreparater du har brukt, og ta det med deg. Du vil også bli spurt om din menstruasjon har opphørt og eventuelt når og hvorfor.

Appendix 6 - Questionnaires Tromsø7

Tromsø-undersøkelsen
2015–2016

KONFIDENSIELT

Skjemaet skal leses optisk. Vennligst bruk blå eller sort penn. Bruk blokkbokstaver. Du kan ikke bruke komma.

Dato for utfylling: ☐☐☐☐☐☐

HELSE OG SYKDOMMER

1.1 Hvordan vurderer du din egen helse sånn i alminnelighet?

Meget god	God	Verken god eller dårlig	Dårlig	Meget dårlig
☐	☐	☐	☐	☐

1.2 Hvordan synes du at helsen din er sammenlignet med andre på din alder?

Mye bedre	Litt bedre	Omtrent lik	Litt dårligere	Mye dårligere
☐	☐	☐	☐	☐

1.3 Har du eller har du hatt?
Sett ett kryss per linje.

	Nei	Ja nå	Før, ikke nå	Alder første gang
Høyt blodtrykk	☐	☐	☐	☐☐
Hjerteinfarkt	☐		☐	☐☐
Hjertesvikt	☐	☐	☐	☐☐
Atrieflimmer *(hjerteflimmer)*	☐	☐	☐	☐☐
Angina pectoris *(hjertekrampe)*	☐	☐	☐	☐☐
Hjerneslag/hjerneblødning	☐		☐	☐☐
Diabetes	☐	☐	☐	☐☐
Nyresykdom *(unntatt urinveisinfeksjon)*	☐	☐	☐	☐☐
Kronisk bronkitt/emfysem/KOLS	☐	☐	☐	☐☐
Astma	☐	☐	☐	☐☐
Kreft	☐	☐	☐	☐☐
Revmatoid artritt *(leddgikt)*	☐	☐	☐	☐☐
Artrose *(slitasjegikt)*	☐	☐	☐	☐☐
Migrene	☐	☐	☐	☐☐
Psykiske plager *(som du har søkt hjelp for)*	☐	☐	☐	☐☐

1.4 Har du langvarige eller stadig tilbakevendende smerter som har vart i 3 måneder eller mer?

☐ Nei ☐ Ja

TANNHELSE

2.1 Hvordan vurderer du din egen tannhelse?

	1	2	3	4	5	
Svært dårlig	☐	☐	☐	☐	☐	Svært god

2.2 Hvor fornøyd eller misfornøyd er du med tennene eller protesene dine?

	1	2	3	4	5	
Svært misfornøyd	☐	☐	☐	☐	☐	Svært fornøyd

BRUK AV HELSETJENESTER

3.1 Har du, grunnet egen helse, i løpet av de siste 12 måneder vært hos:

	Nei	Ja	Antall ganger
Fastlege/allmennlege	☐	☐	☐☐
Legevakt	☐	☐	☐☐
Psykiater/psykolog	☐	☐	☐☐
Legespesialist utenfor sykehus *(utenom fastlege/allmennlege/psykiater)*	☐	☐	☐☐
Tannlege/tannpleier	☐	☐	☐☐
Apotek *(for kjøp/råd om medisiner/behandling)*	☐	☐	☐☐
Fysioterapeut	☐	☐	☐☐
Kiropraktor	☐	☐	☐☐
Akupunktør	☐	☐	☐☐
Alternativ behandler *(homøopat, soneterapeut, healer etc)*	☐	☐	☐☐
Tradisjonell helbreder *(hjelper, «læser» etc)*	☐	☐	☐☐
Har du kommunisert via internett med noen av tjenestene over?	☐	☐	☐☐

3.2 Har du i løpet av de siste 12 måneder vært på sykehus?

	Nei	Ja	Antall ganger
Innlagt på sykehus	☐	☐	☐☐
Konsultasjon ved sykehus uten innleggelse:			
Ved psykiatrisk poliklinikk	☐	☐	☐☐
Ved annen sykehuspoliklinikk	☐	☐	☐☐

BRUK AV MEDISINER

4.1 Bruker du, eller har du brukt, noen av følgende medisiner? *Sett ett kryss per linje.*

	Aldri	Nå	Før, ikke nå	Alder første gang
Medisin mot høyt blodtrykk	☐	☐	☐	
Kolesterolsenkende medisin	☐	☐	☐	
Vanndrivende medisin	☐	☐	☐	
Annen medisin mot hjertesykdom *(f.eks. blodfortynnende, rytmestabiliserende, nitroglycerin)*	☐	☐	☐	
Insulin	☐	☐	☐	
Tabletter mot diabetes	☐	☐	☐	
Stoffskiftemedisin *(Levaxin/thyroxin)*	☐	☐	☐	

4.2 Hvor ofte har du i løpet av de siste 4 ukene brukt følgende medisiner? *Sett ett kryss per linje.*

	Ikke brukt siste 4 uker	Sjeldnere enn hver uke	Hver uke, men ikke daglig	Daglig
Smertestillende på resept	☐	☐	☐	☐
Smertestillende uten resept	☐	☐	☐	☐
Magesyrehemmende medisiner	☐	☐	☐	☐
Sovemidler	☐	☐	☐	☐
Beroligende medisiner	☐	☐	☐	☐
Medisin mot depresjon	☐	☐	☐	☐

4.3 Skriv alle medisiner (reseptfrie og reseptbelagte) du har brukt regelmessig siste 4 uker. *Ikke regn med reseptfrie vitamin-, mineral- og kosttilskudd, urter, naturmedisin etc.*

Får du ikke plass til alle medisinene, bruk eget ark.

KOSTHOLD

5.1 Spiser du vanligvis frokost hver dag?

☐ Nei ☐ Ja

5.2 Hvor mange porsjoner frukt og grønnsaker spiser du i gjennomsnitt per dag? *Med porsjon menes f.eks. et eple, en salatbolle.*

Antall porsjoner

5.3 Hvor ofte spiser du vanligvis disse matvarene? *Sett ett kryss per linje.*

	0–1 pr. mnd.	2–3 pr. mnd.	1–3 pr. uke	4–6 pr. uke	1 eller mer pr. dag
Rødt kjøtt *(alle produkter av storfe, får, svin)*	☐	☐	☐	☐	☐
Grønnsaker, frukt, bær	☐	☐	☐	☐	☐
Mager fisk *(torsk, sei)*	☐	☐	☐	☐	☐
Feit fisk *(laks, ørret, uer makrell, sild, kveite)*	☐	☐	☐	☐	☐

5.4 Hvor mange glass/beger drikker/spiser du vanligvis av følgende? *Sett ett kryss per linje.*

	Sjelden/ aldri	1–6 pr. uke	1 pr. dag	2–3 pr. dag	4 eller mer pr. dag
Melk/yoghurt tilsatt probiotika *(Biola, Cultura, Activia, Actimel, BioQ)*	☐	☐	☐	☐	☐
Fruktjuice	☐	☐	☐	☐	☐
Brus/leskedrikker:					
med sukker	☐	☐	☐	☐	☐
med kunstig søtning	☐	☐	☐	☐	☐

5.5 Hvor mange kopper kaffe og te drikker du daglig? *Sett 0 for de typene du ikke drikker daglig.*

	Antall kopper
Filterkaffe *(trakterkaffe)*	
Kokekaffe og/eller presskannekaffe	
Pulverkaffe	
Espressobasert kaffe *(fra kaffemaskin, kapsler etc)*	
Sort te *(f.eks. Earl Grey)*	
Grønn/hvit/oolong te	
Urtete *(f.eks. nype, kamille, Rooibos)*	

HELSEBEKYMRING

	Ikke i det hele tatt	Litt	Noe	En hel del	Svært mye
6.1 Tror du at det er noe alvorlig galt med kroppen din?	☐	☐	☐	☐	☐
6.2 Er du svært bekymret over helsen din?	☐	☐	☐	☐	☐
6.3 Er det vanskelig for deg å tro på legen din dersom hun/han forteller deg at det ikke er noe å bekymre seg for?	☐	☐	☐	☐	☐
6.4 Er du ofte bekymret for muligheten for at du har en alvorlig sykdom?	☐	☐	☐	☐	☐
6.5 Hvis du blir gjort oppmerksom på en sykdom (f.eks. via TV, radio, internett, avis eller noen du kjenner), bekymrer du deg da for selv å få sykdommen?	☐	☐	☐	☐	☐
6.6 Opplever du at du plages av mange ulike symptomer?	☐	☐	☐	☐	☐
6.7 Har du tilbakevendende tanker (som er vanskelig å bli kvitt) om at du har en sykdom?	☐	☐	☐	☐	☐

FYSISK AKTIVITET

7.1 **Hvis du er i lønnet eller ulønnet arbeid, hvordan vil du beskrive arbeidet ditt?** *Sett kryss i den ruta som passer best.*

- ☐ For det meste stillesittende arbeid *(f.eks. skrivebordsarbeid, montering)*
- ☐ Arbeid som krever at du går mye *(f.eks. ekspeditørarbeid, lett industriarbeid, undervisning)*
- ☐ Arbeid der du går og løfter mye *(f.eks. pleier, bygningsarbeider)*
- ☐ Tungt kroppsarbeid

7.2 **Angi bevegelse og kroppslig anstrengelse i din fritid det siste året.** *Hvis aktiviteten varierer gjennom året, ta et gjennomsnitt. Sett kryss i den ruta som passer best.*

- ☐ Leser, ser på TV/skjerm eller annen stillesittende aktivitet
- ☐ Spaserer, sykler eller beveger deg på annen måte minst 4 timer i uka *(inkludert gang eller sykling til arbeidsstedet, søndagsturer etc)*
- ☐ Driver mosjonsidrett, tyngre hagearbeid, snømåking etc minst 4 timer i uka
- ☐ Trener hardt eller driver konkurranseidrett regelmessig flere ganger i uka

7.3 **Siste uka, omtrent hvor lang tid tilbrakte du sittende på en typisk hverdag og fridag?** *F.eks. ved arbeidsbord, hos venner, mens du så på TV/skjerm.*

☐☐ timer sittende på en hverdag *(både jobb og fritid)*

☐☐ timer sittende på en fridag

ALKOHOL

8.1 **Hvor ofte drikker du alkohol?**

- ☐ Aldri
- ☐ Månedlig eller sjeldnere
- ☐ 2–4 ganger hver måned
- ☐ 2–3 ganger per uke
- ☐ 4 eller flere ganger per uke

8.2 **Hvor mange enheter alkohol (flaske øl, glass vin eller drink) tar du vanligvis når du drikker?**

1–2	3–4	5–6	7–9	10 eller flere
☐	☐	☐	☐	☐

8.3 **Hvor ofte drikker du 6 eller flere enheter alkohol ved en anledning?**

- ☐ Aldri
- ☐ Sjeldnere enn månedlig
- ☐ Månedlig
- ☐ Ukentlig
- ☐ Daglig eller nesten daglig

RØYK OG SNUS

9.1 **Har du røykt/røyker du daglig?**

☐ Aldri ☐ Ja, nå ☐ Ja, tidligere

9.2 **Har du brukt/bruker du snus eller skrå daglig?**

☐ Aldri ☐ Ja, nå ☐ Ja, tidligere

SPØRSMÅL OM KREFT

10.1 **Har du noen gang fått**

	Nei	Ja	**Hvis ja:** alder første gang	**Hvis ja:** alder siste gang
Utført mammografi	☐	☐		
Målt PSA (prostataspesifikt antigen)	☐	☐		
Utført tykktarmsundersøkelse (koloskopi, avføringsprøve)	☐	☐		

10.2 **Har noen i din nære biologiske familie hatt**

	Egne barn	Mor	Far	Mormor	Morfar	Farmor	Farfar	Tante	Onkel	Søsken
Brystkreft	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Prostatakreft	☐		☐		☐		☐		☐	☐
Tykktarmskreft	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

UTDANNING OG INNTEKT

11.1 **Hva er din høyeste fullførte utdanning?** *Sett ett kryss.*

- ☐ Grunnskole/framhaldsskole/folkehøyskole inntil 10 år
- ☐ Fagutdanning/realskole/videregående/gymnas minimum 3 år
- ☐ Høyskole/universitet mindre enn 4 år
- ☐ Høyskole/universitet 4 år eller mer

11.2 **Hva var din husstands samlede bruttoinntekt siste år?**
Ta med alle inntekter fra arbeid, trygder, sosialhjelp og lignende.

- ☐ Under 150 000 kr
- ☐ 150 000–250 000 kr
- ☐ 251 000–350 000 kr
- ☐ 351 000–450 000 kr
- ☐ 451 000–550 000 kr
- ☐ 551 000–750 000 kr
- ☐ 751 000 –1 000 000 kr
- ☐ Over 1 000 000 kr

FAMILIE OG VENNER

12.1 **Hvem bor du sammen med?**

	Nei	Ja	Antall
Ektefelle/samboer	☐	☐	
Andre personer over 18 år	☐	☐	
Personer under 18 år	☐	☐	

12.2 **Har du nok venner som kan gi deg hjelp når du trenger det?**

☐ Ja ☐ Nei

12.3 **Har du nok venner som du kan snakke fortrolig med?**

☐ Ja ☐ Nei

12.4 **Hvor ofte deltar du vanligvis i foreningsvirksomhet som syklubb, idrettslag, politiske, religiøse eller andre foreninger?**

Aldri, eller noen få ganger i året	1–2 ganger i måneden	Omtrent 1 gang i uka	Mer enn 1 gang i uka
☐	☐	☐	☐

SPØRSMÅL TIL KVINNER

13.1 **Hvor gammel var du da du fikk menstruasjon første gang?**

Alder

13.2 **Er du gravid nå?**

☐ Nei ☐ Ja ☐ Usikker

13.3 **Hvor mange barn har du født?**

Antall barn

13.4 **Hvis du har født, fyll ut for hvert barn: fødselsår og vekt samt hvor mange måneder du ammet.** *Angi så godt du kan. Hvis flere barn, bruk ekstra ark.*

	Fødselsår	Fødselsvekt i gram	Ammet ant. mnd.
Barn 1			
Barn 2			
Barn 3			
Barn 4			
Barn 5			
Barn 6			

SPØRSMÅL TIL MENN

14.1 **Har du fått behandling for betennelse i prostata eller urinblæra?**

☐ Nei ☐ Ja

14.2 **Har du fått utført steriliseringsoperasjon?**

☐ Nei ☐ Ja **Hvis ja:** hvilket år

Tusen takk for ditt bidrag.