UiT The Arctic University of Norway

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The associations of alcohol consumption with smoking cessation and weight change

Tromsø Study waves six and seven

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Abstract

Background: Alcohol consumption, overweight and smoking are among the major causes of morbidity and mortality worldwide. These behaviors tend to co-occur and often differ between different socioeconomic groups. Previous studies have indicated a reversed social gradient in total alcohol consumption. Alcohol-related conditions are associated with premature mortality, and a better understanding of the social differences and how alcohol is related to other health-related behaviors is important in order to make policies and interventions reducing alcohol-related harms. The main purpose of this study was to investigate the social gradient in total alcohol consumption and its relationship with smoking cessation and weight change.

Methods: This repeated-measures study included 12 624 adults from the sixth (2007-08; age 30+) and 20 718 from the seventh wave (2015-16; age 40+) of the Tromsø Study (8 884 participating in both waves). First, the distribution of total alcohol consumption was assessed across education groups – both at a cross sectional level in each wave, and in the change in total alcohol consumption from the sixth wave to the seventh. Second, the association between alcohol consumption and smoking cessation and weight change was assessed. Last, exploratory analyses on the association between change in alcohol consumption with smoking cessation and weight change were initiated. Multiple linear and binary logistic regression models were used to analyze the associations, adjusting for several potential confounders.

Results: A reversed social gradient in total alcohol consumption was found both in men and women, where higher educational attainment was associated with a higher total alcohol intake. The total alcohol consumption increased from the sixth to the seventh wave for both women and men. For women only there was a larger increase in total alcohol consumption among those with the highest educational attainment compared to those with the lowest educational attainment. Alcohol consumption at the sixth wave was not significantly associated with smoking cessation or weight change. However, exploratory analysis revealed a significant association between a decrease in alcohol consumption and weight loss in men and higher odds for smoking cessation in women.

Conclusion: Higher educational attainment is associated with higher total alcohol consumption, and in women the educational differences has increased. At the same time the more educated had a higher tendency to quit smoking and gained less weigh, indicating

different attitudes towards alcohol compared to other health related behaviors. Total alcohol consumption at one time point does not seem to be a good predictor for smoking cessation and weight change, while a reduction in alcohol intake from one time point to another seems to be associated with higher odds for smoking cessation in women and less weight gain in men in the same time period.

Abbreviations

BMI	Body mass index
NCD	Non-communicable disease
NSD	Norwegian Centre for Research Data
OR	Odds ratio
REK	Regional Committees for Medical and Health Research Ethics
SES	Socioeconomic status
SDGs	Sustainable Development Goals
SWB	Subjective well-being
SWLS	Satisfaction with life scale
T6	The sixth wave of the Tromsø Study
T7	The seventh wave of the Tromsø Study
VAS	Visual analogue scale
Q1	Questionnaire 1
Q2	Questionnaire 2

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1 Introduction

1.1 Inequalities in health

"Social inequalities" refers to differences in health that are associated with individuals' socioeconomic position or status (SES). It is commonly measured using education, income and occupation and are meant to provide information about an individual's access to social and economic resources (Duncan, Daly, McDonough, & Williams, 2002). When claiming that there are social inequalities in health, we assume there are underlying social mechanisms that to some extent can help explain the association between health and SES that we observe. This suggests that there are certain socioeconomic positions that act as an underlying factor for differences in health or health-related behaviors. If this is the case, we can reduce inequalities in health by reducing socioeconomic differences (Norwegian Directorate of Health, 2016). It could be argued that SES itself is not likely to be an agent causing good health, but rather that underlying differences in behavior mediate this association.

Individuals with the highest educational attainment live on average 5 to 6 years longer, have better health, smoke less and have a lower body mass index (BMI) compared to individuals with the lowest education attainment in Norway (Norwegian Institute of Public Health, 2018b). Smoking, physical inactivity, obesity and high alcohol consumption are four of the main threats to public health in Norway today (Norwegian Directorate of Health, 2018a, 2018c). These health-related behaviors are among the major causes of morbidity and mortality in both high- and lower income countries (Lim et al., 2013; World Health Organization, 2018), and healthy behaviors are likely to protect both somatic, mental (Stranges, Samaraweera, Taggart, Kandala, & Stewart-Brown, 2014), and cognitive health (Lee et al., 2010).

Normally, we assume that the social gradient is positive – the higher the education, the better the health related behavior, and further health (Adler et al., 1994; Cutler & Lleras-Muney, 2010; Norwegian Directorate of Health and Social Affairs, 2005). While this is the case for BMI, smoking and physical activity, the relationship between SES and alcohol is not as clear. It seems that higher SES is related to higher total alcohol consumption – a 'reversed social gradient' (Adler et al., 1994; Norwegian Directorate of Health, 2016), but less alcohol related problems, diseases and deaths (Norwegian Directorate of Health, 2016). Norway is among the

countries with the largest differences in social inequalities in health-related behaviors, despite the low degree of social differences compared to many other countries (Norwegian Directorate of Health, 2016; Norwegian Directorate of Health and Social Affairs, 2005). The association between low SES and poor health could be caused by a variety of reasons, such as poorer living conditions, less access to health care, limited knowledge about health risk behaviors, and psychological stress (Adler et al., 1994; Marmot, Kogevinas, & Elston, 1987).

1.1.1 Reducing social inequalities in health

A social gradient in health outcomes is well documented (Marmot, 2005). The Norwegian "Public Health Law" states that public health efforts shall promote the health, wellbeing and good social and environmental conditions, as well as prevent mental and somatic illness, injury and suffering. The purpose of this law is to contribute to a community development that promote public health and reduce social differences in health (Folkehelseloven, 2011). It is often argued that inequalities in health are unfair. To reduce these differences is generally cost-efficient and the consequences affects the society as a whole (Woodward & Kawachi, 2000).

1.2 Alcohol

Alcohols are consumed almost worldwide, it is the most widely used recreational drug (World Health Organization, 2018) and accounts for a growing burden of death and disability (Forouzanfar et al., 2016; Mackenbach et al., 2015). It is one of the leading risk factors for population health and a high alcohol consumption is related to a number of undesirable health outcomes (Ferrari et al., 2014; World Health Organization, 2018). Over time alcohol increases the risk for both mental and somatic health conditions in addition to alcohol dependence itself. Not only can it result in diseases over time, it also increases the risk of accidents, violence and crime (Norwegian Directorate of Health, 2016; Skretting, Vedøy, Lund, & Bye, 2017). Nevertheless, moderate alcohol consumption has also been associated with positive health outcomes, such as decreased risk of type two diabetes (J. Huang, Wang, & Zhang, 2017; Li, Yu, Zhou, & He, 2016) and cardioprotective effects (Brien, Ronksley, Turner, Mukamal, & Ghali, 2011; Roerecke & Rehm, 2014; Ronksley, Brien, Turner, Mukamal, & Ghali, 2011). However, findings are ambiguous (Roerecke & Rehm, 2012) and there is a lack of randomized trials to support the health benefits due to moderate alcohol intake (O'Keefe, Bybee, & Lavie, 2007). One possible explanation is that nondrinkers include several different groups that have unique mortality risks and that this may be why there seems to be a

protective effect from light/moderate alcohol consumption (Rogers, Krueger, Miech, Lawrence, & Kemp, 2013). There are also studies suggesting that different types of alcohol can have different effects on a number of health outcomes (Artero, Artero, Tarín, & Cano, 2015; Grønbæk et al., 2000; Hansen-Krone, Brækkan, Enga, Wilsgaard, & Hansen, 2011).

Although alcohol mostly is considered a public health threat at the global and community levels, it can also be interpreted as a fun and joyful activity on an individual, hedonic level (Room, 2000). Subjective well-being (SWB), a self-reported measure of well-being, depends on a complex interaction of factors such as SES, health, social relations, personality traits and genes, as well as the environment the individual lives in (Binder & Coad, 2013). Based on the available evidence, it seems that alcohol consumption leads to happiness at the moment of drinking (Geiger & MacKerron, 2016), but does not have a positive impact on SWB over time, and drinking problems are associated with lower life satisfaction (Geiger & MacKerron, 2016). Of different conditions of bad health, alcohol and drug-abuse together has been observed to have the strongest negative effect on SWB in Britain (Binder & Coad, 2013). Self-rated health has been shown to be strongly associated with mortality (Idler & Benyamini, 1997; Mossey & Shapiro, 1982), and several studies have tried to understand the relationship between alcohol and self-rated health the last 20 years (Abuladze, Kunder, Lang, & Vaask, 2017; Grønbæk et al., 1999; Guallar-Castillón et al., 2001; Poikolainen & Vartiainen, 1999; Riediger, Bombak, & Mudryj, 2019; Stranges et al., 2006; Van Dijk, Toet, & Verdurmen, 2004). Results are inconsistent, and this can be due to different measures of alcohol and different populations.

There is little doubt that alcohol consumption causes a large burden both to the society and to individuals and therefore should not be prescribed for health enhancement to nondrinking individuals (O'Keefe et al., 2007). Alcohol contributes to increased inequalities within as well as between countries, and harms from a given amount of alcohol have higher consequences for poor drinkers than for rich drinkers (World Health Organization, 2018). Because of the many and serious ways alcohol can impact individuals and the society as a whole in a negative way, it is important to understand more about how the consumption and negative impacts of it differs across different groups in the population. This is crucial in order to make policies that can decrease the negative impacts of alcohol altogether. A reduction in alcohol consumption is important to improve public health, and Norway has set a goal to reach the Global NCD-target of a 10 percent reduction of the harmful alcohol consumption by 2025 (Norwegian Directorate of Health, 2018c). Reducing the use and harms of alcohol is also

important in order to reach several of the Sustainable Development Goals (SDGs) (World Health Organization, 2018).

1.2.1 Current guidelines

The World Health Organization (WHO) advises men and women not to exceed two standard drinks (10g pure ethanol) per day (Higgins-Biddle & Babor, 2001). Still guidelines for alcohol consumption differ across countries. To compare guidelines is quite challenging since countries use different definitions of how many grams one standard unit is, ranging from 8 to 20 grams per unit (Kalinowski & Humphreys, 2016). Also, some countries present guidelines for alcohol per day and others per week. Some have guidelines for both per day and per week, where these do not match. The Norwegian nutrition guidelines recommend no more than 10g of alcohol per day for women and no more than 20g per day for men, which equals approximately 7 units (70g) per week for women and 14 units (140g) per week for men (Norwegian Directorate of Health, 2014). In the USA it is recommended to have an alcohol intake below 196g per week for men and 98g for women. In the UK recommendations are around half of the amount recommended by US guidelines per day. Among the highest limits for recommended units per week we find Poland's and Vietnam's guidelines recommending below 280g per week for men and 140g for women (Kalinowski & Humphreys, 2016).

According to a prospective cohort study of 599 912 individuals by Wood et al. (2018), most national recommendations for alcohol intake have too high limits. Drinking above both UK and US limits was associated with reduced life expectancy in both men and women at the age of 40. There was no clear threshold where lower alcohol consumption stopped being associated with lower risk for cardiovascular disease subtypes other than myocardial infarction, suggesting that even a moderate alcohol intake can be harmful.

1.2.2 Alcohol consumption in Norway

Harmful use of alcohol and alcohol dependency are the most common substance use disorders among Norwegians, and Norway is among the countries with the highest prevalence of episodic high alcohol intake (binge drinking) (Norwegian Directorate of Health, 2018b). 34% of the total population in Norway drinks alcohol weekly (39% of men and 28% of women) (Statistics Norway, 2019b). In 2019 it was reported that Norwegians bought on average above six liters of pure alcohol per year, and men consumed approximately twice as much as women (Norwegian Institute of Public Health, 2018b; Statistics Norway, 2019a). This does not include unrecorded consumption such as border-trade, tax-free commerce, private import and

illegal smuggling of alcohol. We can therefore expect the true alcohol consumption to be higher (Skretting et al., 2017). The Public Health Report for the counties Troms and Finnmark (Skogen, Vedaa, Nilsen, Nes, & Aarø, 2019) shows a clear reversed social gradient and age trend, where the proportion reporting to drink twice a week or more increase with education and age. Respondents from the Tromsø area reported more frequently to drink twice a week or more, compared to all other regions included. There were no significant differences in episodic high alcohol consumption (six or more units at the same occasion) across education groups, but a clear age trend where respondents from the youngest age group (18-29) most frequently reported binge drinking (Skogen et al., 2019). At the same time the total alcohol consumption is declining in adolescents and young adults (Norwegian Institute of Public Health, 2018b).

1.2.3 The social gradient in alcohol consumption

The fact that there are social differences in alcohol consumption and abuse is well established, but exactly what aspects of alcohol consumption where a social gradient is applicable is not as clear. It seems to differ according to how alcohol and SES is measured (Norwegian Directorate of Health, 2016). The higher total alcohol consumption and lower prevalence of abstention among individuals with higher SES is apparent, both in Norway (Horverak & Bye, 2007; Strand & Steiro, 2003), and in other developed countries (Knupfer, 1989; Marmot, 1997; Osler et al., 2001; Peña et al., 2017). When it comes to the most harmful alcohol consumption, binge drinking, both direction and strength of the social gradient varies across studies, countries, genders, age groups and measurement used for measuring binge drinking (Norwegian Directorate of Health, 2016). It appears that lower SES groups are more vulnerable to alcohol dependence and alcohol related diseases (Norwegian Directorate of Health, 2016; van Oers, Bongers, van de Goor, & Garretsen, 1999). Katikireddi, Whitley, Lewsey, Gray, and Leyland (2017) found that individuals from socially disadvantaged groups had greater alcohol-attributable harms compared with those from advantaged areas for given levels of alcohol consumption. This was still the case after accounting for different drinking patterns, obesity, and smoking status at the individual level.

The relationship between SES and alcohol and alcohol related problems is complex. When seeking to reduce the harms of alcohol by reducing social differences one assumes that SES is (at least a part of) the cause of alcohol consumption. It is also reasonable to assume that it can go the other way - that alcohol related problems can impact occupational status and income.

The Norwegian Directorate of Health (2016) conclude that while it may both ways, the most established pathway is that SES impacts alcohol related problems through alcohol use and drinking pattern, and that lower SES groups are more vulnerable to alcohol related diseases compared to higher SES groups with the same alcohol consumption and drinking pattern.

1.2.4 Gender differences in alcohol consumption

Previous studies show a gender difference in alcohol consumption. Men generally drink more, are less likely to abstain, and are more likely to suffer consequences as a result of a high alcohol intake (Holmila & Raitasalo, 2005; Hupkens, Knibbe, & Drop, 1993; Meader et al., 2016; Wilsnack, Vogeltanz, Wilsnack, & Harris, 2000). This gender difference in alcohol intake is also apparent in Norway (Skogen et al., 2019; Statistics Norway, 2019b). Previous studies of alcohol in the Tromsø study has also shown gender differences in alcohol consumption and health related risks associated with alcohol consumption (Brenn, 1986; Sexton, Lipton, & Nilssen, 1999; Wilsgaard & Jacobsen, 2007), supporting separate analyses for men and women.

1.2.5 Co-occurrence of alcohol with other health-related behaviors

There is a growing body of evidence suggesting that behavioral risk factors such as smoking, physical activity, BMI, nutrition and alcohol tend to occur together (Matthews et al., 2017; Noble, Paul, Turon, & Oldmeadow, 2015). The health consequences of more adverse health behavior can not necessarily be predicted by simply adding the risk of the different health-related behaviors separately. Combinations of health risk factors may be more harmful than their cumulative individual effects (Berrigan, Dodd, Troiano, Krebs-Smith, & Barbash, 2003; Poortinga, 2007; World Health Organization, 2018). Still health interventions tend to target one health-related behavior at a time. A systematic review of the clustering of health-related behaviors and the associated socio-demographic characteristics including 56 studies, found a distinct healthy cluster with absence of inexpedient health-related behaviors, and around 50 percent of the studies included detected a cluster of all inexpedient health behaviors (Noble et al., 2015). There are mainly two mechanisms that may explain cooccurrences like this: that the presence of one inexpedient health behavior increases the likelihood of participating in more unhealthy behavior, or that there are underlying mechanisms such as genes or environmental factors increasing the likelihood of unhealthy behaviors altogether (Verweij, Treur, & Vink, 2018). It is also possible that there can be combinations of the two.

1.2.5.1 Alcohol and smoking

Tobacco smoking is widely known as one of the leading risk factors for cardiovascular and respiratory diseases as well as different types of cancer (U.S. Department of Health and Human Services, 2014). Smoking increases stress levels and while smoking cessation may cause unpleasantness in the short run, it generally leads to reduced anxiety and depression, improved mood and better psychological quality of life (Taylor et al., 2014). The last 10 years there has been a positive trend in Norway where fewer young people start smoking and more smokers have quit smoking (Norwegian Directorate of Health, 2018c). In Troms and Finnmark in 2019, 10% reported to be daily smokers (Skogen et al., 2019) which is similar to the general population in Norway (Statistics Norway, 2019b). There is a clear social gradient with the frequency of smoking decreasing with years of education, and a reversed U-shaped distribution for age with the age group 50-59 most frequently reporting to be daily smokers (Skogen et al., 2019).

Alcohol and smoking seems to be the health-related behaviors that most often cooccur, and the most vulnerable are men and socially disadvantaged groups (Meader et al., 2016; Noble et al., 2015). Individuals misusing alcohol seems to have a higher risk of dying from illnesses and diseases related to tobacco smoking than from those related to alcohol (Hurt et al., 1996; Mendelsohn & Wodak, 2016). Smoking can also trigger relapse to alcohol among adults with alcohol use disorders (Weinberger, Platt, Jiang, & Goodwin, 2015). Twin-studies indicate that genetics plays an important role in the clustering of alcohol and smoking, especially for individuals with alcohol disorders (Hopfer, Stallings, & Hewitt, 2001; True et al., 1999). It seems that it is mainly alcohol intake that increases smoking behavior (Field, Mogg, & Bradley, 2005; McKee, Krishnan-Sarin, Shi, Mase, & O'Malley, 2006) but that smoking also can have an effect on alcohol self-administration in certain contexts (Berg, Piper, Smith, Fiore, & Jorenby, 2015; Dermody & Hendershot, 2017). There are also concern about smoking cessation possibly leading to an increased alcohol consumption in men (Carmelli, Swan, & Robinette, 1993), while other studies have indicated that alcohol consumption does not change (Kahler et al., 2010) or is reduced after smoking cessation (Berg et al., 2015). One explanation for these differences could possibly be different motivations individuals can have for smoking cessation. If you quit smoking as a part of a plan to lead a healthier life, it seems more likely to also reduce your high alcohol intake. Both alcohol and smoking alone can impair health. Although their combined effect is not yet fully understood, together they seem to increase the risk of a number of adverse health outcomes (Kvaavik, Batty, Ursin, Huxley,

& Gale, 2010; Loef & Walach, 2012). Several studies has demonstrated that alcoholic smokers have reduced brain volume and poorer cerebral perfusion compared to alcoholic non-smokers (Durazzo, Cardenas, Studholme, Weiner, & Meyerhoff, 2007; Durazzo, Mon, Gazdzinski, & Meyerhoff, 2013; Gazdzinski et al., 2005). However, a recent pathological study of smoking in alcoholics and controls could not find such an additional effect of smoking in combination with alcohol (McCorkindale, Sheedy, Kril, & Sutherland, 2016).

1.2.5.2 Alcohol and weight

The obesity epidemic is a growing health challenge worldwide and is associated with a number of adverse health consequences such as cardiovascular diseases, cancers, type 2 diabetes and musculoskeletal pain (Abarca-Gómez et al., 2017; Norwegian Directorate of Health, 2018c; Swinburn et al., 2019). Obesity is a complex disorder that develops from genotype and environmental interactions (T. Huang & Hu, 2015). Both national and international recommendations for BMI suggests that a BMI between 18.5 and 25 is healthy, below 18.5 is considered underweight, 25 to 30 overweight and above 30 obese. The highest health risk appears above a BMI of 30, and this is the case for about one in every five Norwegian (Norwegian Directorate of Health, 2011). Around 33% of men and 23% of women (total 28%) in Norway has a BMI of 27 or above, and for the county Troms and Finnmark the proportion is even higher (Statistics Norway, 2016). Similar to smoking, the frequency of overweight decreases by years of education, and it is highest for middle-aged age groups, both in men and women (Skogen et al., 2019).

Alcohol contains energy (7.1 kcal/g) and several studies have indicated that alcohol, especially a high consumption, is associated with access weight (Sayon-Orea, Martinez-Gonzalez, & Bes-Rastrollo, 2011). In addition, many alcoholic beverages contain high levels of sugar which can also contribute to weight grain. Alcohol acts pharmacologically on the nervous system and it has higher priority for oxidation compared to fats and carbohydrates (Sayon-Orea et al., 2011). When consumed in amounts resulting in intoxication, alcohol can also affect individuals ability to evaluate the need for food in relation to energy use (Casbon, Curtin, Lang, & Patrick, 2003) and has a tendency to enhance food intake (Yeomans, 2010). By enhancing short-term rewarding effects of food, also lower amounts of alcohol can increase food intake when consumed before a meal (Yeomans, 2010). For food intake to result in weight gain, the increased calorie intake needs to happen over time. While light to moderate alcohol intake does not seem be related to weight change, heavy drinking (2-3 drinks per day) seems to be associated with weight gain (Sayon-Orea et al., 2011). The effect

of alcohol intake on weight may also differ between different types of alcoholic beverages and different drinking patterns (Sayon-Orea et al., 2011; Yeomans, 2010). An important distinction between a high alcohol consumption and alcohol dependence is that the latter often is associated with malnutrition (Yeomans, 2010). There is not a clear agreement to whether alcohol consumption leads to weight gain, but it is likely that at least heavy drinkers may experience weight gain more commonly than light drinkers (Sayon-Orea et al., 2011). Since the rates of alcohol consumption has remained fairly stable, with a small increase, at the same time as overweight and obesity has increased rapidly, alcohol use alone cannot be the explanation for the obesity epidemic. But it can still be an important component.

2 Study objectives

2.1 Rationale

Health-related behaviors such as alcohol, overweight, physical inactivity and smoking are among the major causes of morbidity and mortality worldwide. These behaviors tend to cooccur and they often differ between different socioeconomic groups. This contributes to increasing social differences in health. A high alcohol consumption (above 14 units weekly) is the health-related behavior with the lowest prevalence in Norway and while the other health risk behaviors are more prevalent among those with lower education, a high alcohol consumption seems to be most prevalent in higher education groups – those with the best health. Because of the tendency of clustering of health risk factors, it is of interest to explore if alcohol indirectly can affect other health-related behaviors, and further health.

This repeated-measures study explores if alcohol consumption is associated with smoking cessation and weight change. Because of the difference in health behaviors across different socioeconomic groups, the social gradient in these behaviors, especially in alcohol consumption, is of great interest. The population of interest is the general population in Tromsø, a municipality in Northern Norway. A high or unhealthy alcohol consumption refers to a more than 14 units per week, and a moderate alcohol consumption refers to above 7 to 14 units per week. Because of different alcohol guidelines across countries, and the apparent disagreement about whether a consumption between 7 to 14 units is harmful, this group in particular is of great interest. This study does not look into alcoholism as a disorder, but a high alcohol intake in the general population. Only the total self-reported alcohol

consumption is assessed, and different types of alcohol and drinking pattern are not taken into account.

2.2 Research question

Is alcohol consumption associated with smoking cessation and weight change?

2.3 Aims

1. To examine the extent of inequalities in total alcohol consumption across educational groups.

2. To explore the relationship between high alcohol consumption and the lifestyle risk factors smoking and weight.

2.4 Hypotheses

1. a) Total alcohol consumption in units per week differs across different educational groups in T6 and T7 separately.

b) There is a social gradient in the change in alcohol consumption from T6 to T7 for individuals participating in both waves.

2. a) There is an association between alcohol consumption in T6 and smoking cessation from T6 to T7.

b) There is an association between alcohol consumption in T6 and weight change from T6 to T7.

3 Materials and methods

The main purpose of this repeated measures study is to investigate to what extent total alcohol consumption can predict smoking cessation and weight change from the sixth to the seventh wave of the Tromsø study. First, by examining the distribution of high alcohol consumption across socioeconomic groups. And second, by assessing the association between alcohol consumption and the health-related behaviors smoking cessation and weight change.

3.1 The study population

This study is based on individual-level data of a comprehensive health survey of the adult population residing in the city of Tromsø in 2007/8 (N = 12 984, age 30+) and 2015/16 (N = 21 083, age 40+). Tromsø is the largest city in Northern Norway, with around 80 000 inhabitants. The Tromsø Study is an on-going prospective cohort study, including seven waves conducted between 1974 and 2015-2016. Except a slight overrepresentation of individuals holding a university degree, the study population is considered broadly representative of the Norwegian adult population. The design of the Tromsø Study is described in detail elsewhere (Eggen, Mathiesen, Wilsgaard, Jacobsen, & Njølstad, 2013; Jacobsen, Eggen, Mathiesen, Wilsgaard, & Njølstad, 2011; University of Tromsø, n. d.-a).

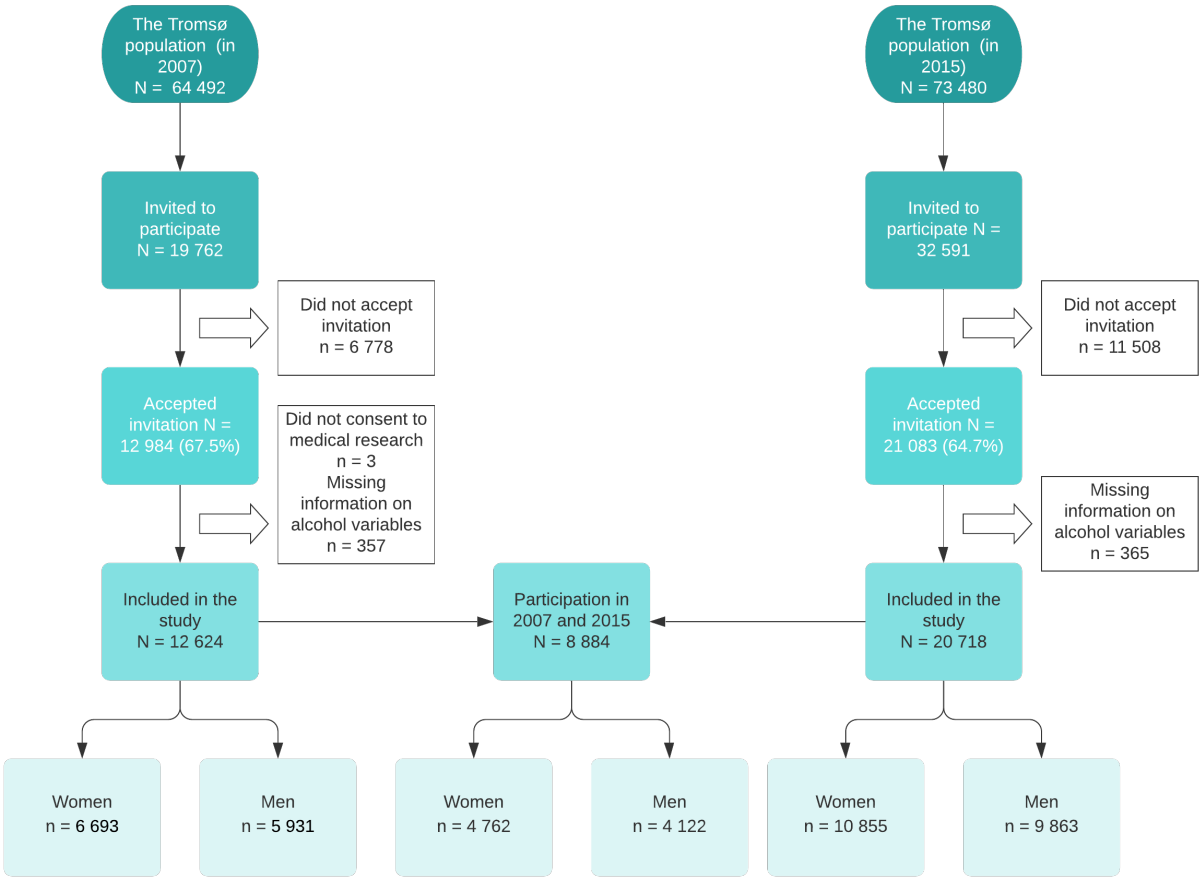

Figure 1: Flow chart of the studied population

3.2 Exclusion and inclusion criteria

Data was obtained from the sixth and the seventh Tromsø Study. Participants with missing information on alcohol units or frequency was excluded from this study (the included variables are explained in detail in 3.3). This resulted in 357 participants being excluded in T6 and 365 in T7, see Figure 1 above for flow chart. Not all participants answered all questions which led to different numbers of participants for the independent variables. There were no missing numbers for the variables sex and age. For the other variables there was a large variation in the amount missing for each variable. Complete case analyses were performed, leaving out missing variables and including only complete cases.

3.3 Variables used in the analyses

Variables in the main analyses were obtained from the Questionnaire 1 (Q1) in T6 and T7 (see attached Q1 from T6 in Appendix 1, and Q1 from T7 in Appendix 2).

3.3.1 Alcohol consumption

Alcohol consumption was obtained from both the sixth and seventh Tromsø study, where respondents answered the following questions: First, "How often do you drink alcohol", with the following options "never", "monthly or less frequently", "2-4 times a month", "2-3 times a week" and "4 or more times a week". Second, those who responded any option except "never" were asked "How many units of alcohol (a beer, a glass of wine or a drink) do you usually drink when you drink alcohol?" with five possible answers: "1-2", "3-4", "5-6", "7-9" and "10 or more". A variable for alcohol units per week was computed based on these two variables as shown in Appendix 3. This was originally a continuous variable and in addition a categorical variable was created consisting of 4 levels ([0-3], (3-7], (7-14], above 14). A variable for change in alcohol consumption was calculated by subtracting the consumption in T6 from that in T7.

3.3.2 Smoking

Smoking status was obtained from both the sixth and seventh Tromsø Study. Respondents were asked "Do you/did you smoke daily?", and the options were "yes, now", "yes, previously" and "never". In the analyses smoking was treated as a dichotomous variable, and "yes, now" was considered current smokers and "yes, previously" and "never" was treated as not current smokers. A variable for smoking cessation was computed for those reporting to be smokers in T6.

3.3.3 Body mass index and weight

Information on the respondent's body weight and height were objectively measured at the time of each survey. For both waves, a continuous variable was calculated using the formula for body mass index expressed in kg/m^2. A variable for weight change was computed by subtracting the weight at T6 from that in T7.

3.3.4 Socioeconomic status

Socioeconomic status is measured by education level which was obtained from the question "What is the highest level of education you have completed?". From T6 there are 5 categories and from T7 there are 4 categories. In T6 the options were "Primary/secondary school, modern secondary school", "Technical school, vocational school, 1-2 years senior high school", "High school diploma", "College/university less than 4 years", "College/ university 4 years or more". In T7 the options were "Primary/partly secondary education. (Up to 10 years of schooling)", "Upper secondary education: (a minimum of 3 years)", "Tertiary education, short: College/university less than 4 years", "Tertiary education, long: College/ university 4 years or more". The 5 categories in T6 were converted to 4 categories matching the categories from T7 by collapsing the second and the third group.

3.3.5 Covariates

From T6 and T7 the variables sex and age were obtained, and all analyses were preformed separate for genders. Age was treated as a possible confounder. Because of an imbalance in marital status, with few single men in the Tromsø Study, this was adjusted for. "Do you live with a spouse/partner?" (yes/no) was used to adjust for this. In addition, smoking and education (described above) was treated as possible confounders when appropriate.

3.3.6 Self-rated health and subjective well-being

Self-rated health and subjective wellbeing (SWB) were included in exploratory analyses as measures for overall health and wellbeing from Questionnaire 2 (Q2) in T7. The direct assessment of health on a visual analog scale (VAS) is based on answers to the question: "Think about a scale of 0 to 100, with zero being the least desirable state of health that you could imagine and 100 being perfect health (physical, mental and social). What rating from 0 to 100 would you give to the state of your health?", where respondents marked their answer on a vertical line.

SWB was assessed by the satisfaction with life scale (SWLS), which has been widely used in previous studies with favorable psychometric properties. The first three of the five SWLS-items was used: “In most ways my life is close to my ideal”; “The condition of my life is excellent”, and; “I am satisfied with my life”. The response options ranged from 1 (strongly disagree) to 7 (strongly agree). In the analyses, SWB has been measured by taking the summary score of its first three items, ranging between [3 – 21] and converting it to a continuous variable with a [0-100] scale.

3.4 Ethical considerations

The sixth and seventh waves of the Tromsø Study has been approved by the Norwegian Data Inspectorate and by the Regional Committee for Medical and Health Research Ethics (REK), North Norway. It has been performed in accordance with the ethical standards of the 1964 Declaration of Helsinki, International Ethical Guidelines for Biomedical Research Involving Human Subjects and the International Guidelines for Ethical Review of Epidemiological Studies. Participation was voluntary and each subject gave written informed consent prior to participation.

This project is a part of an NFR-financed project (273812) ‘Tracing causes of inequalities of health and wellbeing’, which has been approved by REK. A notification form regarding this master’s project was sent to the Norwegian Centre for Research Data (NSD). The dataset was stored on an encrypted USB-stick with a 7-digit password.

3.5 Statistical analyses

All analyses were performed using IBM SPSS Statistics version 26.0.0.1 for mac. The tables were produced in Microsoft Word, flow chart produced in the webpage www.lucidchart.com, and bar graphs were created using IBM SPSS. The statistical tests were two-sided, and for all analyses results with a significance level < .05 were considered significant. For linear and logistic regression, 95% confidence intervals for estimates were reported. All analyses were performed separate for women and men. For reporting of results, the general reporting recommendations for observational studies provided by STROBE were followed (Vandenbroucke et al., 2014).

3.5.1 Descriptive statistics

To assess a possible difference in characteristics between included and excluded participants, t-tests and chi-square tests were conducted between missing values and no missing values on

alcohol variables. For all t-tests, if the Levene's test for equality of variances was significant ($p < .05$, indicating violation of the assumption of equality of variances), degrees of freedom (df) and t-statistic for equal variances not assumed were reported.

Because all analyses were performed separate for sexes, it was not necessary to provide tests for difference in sample characteristics between men and women.

3.5.2 Confirmatory analyses

The possible confounders age, marital status, and smoking status was initially included in separate blocks in hierarchical regression analyses and was removed from the analyses if they were not significantly contributing to the model ($p > .05$). For all regression analyses preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. If assumptions were not fully met, this was explored further. There were no incidents where it was deemed necessary to change or exclude values. The p-trends for categorical independent variables were estimated by including it as a continuous variable (instead of a categorical variable) in each block.

3.5.2.1 The social gradient in alcohol consumption

To explore the social gradient, two hierarchical multiple regression analyses (separate for T6 and T7) were performed with total alcohol consumption (units/week) as the dependent variable. These analyses included all participants in each wave responding to the variables included in the analyses.

To explore if there was a social gradient in the change in alcohol consumption from T6 to T7, only individuals responding in both the sixth and the seventh wave were included. The change in alcohol consumption was calculated by subtracting the consumption at T6 from that from T7. Further a possible social gradient in the change in alcohol consumption was explored by means of linear regression. To assess if the mean change in alcohol consumption had increased significantly and if this was different between genders, t-tests were performed.

3.5.2.2 The effect of alcohol consumption on smoking and weight

Smoking was divided into a binary variable for smoking cessation. A binary logistic regression analysis was performed to assess whether smoking cessation could be predicted by alcohol consumption (at T6) when adjusting for possible confounders. This analysis only included participants who reported being current smokers in T6.

The change in weight (kg) was calculated from T6 to T7 as a continuous variable. A linear regression analysis was performed to explore whether weight change could be explained by alcohol consumption when adjusting for possible confounders. This analysis only included participants with a BMI >25 in T6 and/or T7. This was because only an unhealthy (increase in weight beyond BMI 25) or healthy weight change (decrease in weight towards BMI 25 or from a BMI over 25 to under 25) was of interest, and not a weight change within what is considered to be healthy. Underweight (BMI < 18.5) was not assessed because of few participants in this group, in addition to underweight being a different kind of public health challenge than overweight and obesity.

3.5.3 Exploratory analyses

To explore the results from the main analyses further, explorative analyses were performed. It is important to distinguish between confirmatory and exploratory analyses. The purpose of confirmatory analyses (hypothesis testing) is to explore if one can find evidence for a hypothesis that is stated beforehand. The purpose of exploratory analyses on the other hand, is to assess a relationships without having stated this beforehand (Jaeger & Halliday, 1998). Exploratory research may lead to the development of new knowledge and extending existing theories.

First, a linear regression analysis with weight change as the dependent variable and change in alcohol units per week as the independent variable was performed. Possible confounders were included in separate blocks in the same manner as all regression analyses in the confirmatory part. The analysis was performed in order to assess a possible correlation between weight change and alcohol change from T6 to T7 when adjusting for possible confounders. Second, a binary logistic regression analysis was performed with smoking cessation as the dependent variable, and alcohol change as the predictor to see if there could be a correlation between the change when adjusting for possible confounders.

Last, by means of descriptive statistics, the health-related outcomes percent of smokers, BMI, self-rated health and SWB were explored across different levels of alcohol consumption in T7 only. This was done in order to see if there were a difference between groups, and if, based on this, could be reason to be concerned for the health of individuals consuming >7-14 units per week. P-values for smoking were retrieved by means of chi-square tests, and p-values for BMI, self-rated health and SWB were retrieved by one-way ANOVA.

4 Results

4.1 Comparison between included and excluded participants

357 participants from T6 and 365 from T7 were excluded from the study as a result of missing values on alcohol variables. T-tests and chi-square tests for differences between missing values and no missing values on alcohol variables separate for sex, are presented in Table 1. There was a significant age-difference between included and excluded participants, both for women in T6 (M_{diff} = 11.76, $t(252)$= 14.62 , $p < .001$) and men in T6 (M_{diff} = 10.28, $t(127)$= 10.58, $p < .001$), women in T7 (M_{diff} = 9.92, $t(11072)$ = 12.78, $p < .001$) and men in T7 (M_{diff} = 8.68, $t(10007)$ = 9.17, $p < .001$), where the excluded participants were older than the included. There were also significant differences in education between included and excluded participants, both for women in T6 ($\chi^2(3)$ = 109, $p < .001$), men in T6 ($\chi^2(3)$ = 54.1, $p < .001$), women in T7 ($\chi^2(3)$ = 67.5, $p < .001$) and men in T7 ($\chi^2(3)$ = 27.0, $p < .001$), with included participants having a higher educational attainment than excluded participants. There were more smokers among excluded participants in women in T6 ($\chi^2(1)$ = 6.46, p = .011), but no significant differences in smoking status between included and excluded participants in men in T6 and women and men in T7. There were fewer individuals living with a partner or spouse among excluded participants, both in women in T6 ($\chi^2(1)$ = 23.73, $p < .001$), men in T6 ($\chi^2(1)$ = 4.28, p = .039), women in T7 ($\chi^2(1)$ = 18.44, $p < .001$) and men in T7 ($\chi^2(1)$ = 5.28, p = .022). Included women in T7 reported better health compared to excluded women (M_{diff} = 6.40, $t(205)$ = 4.63 , $p < .001$), and included men in T7 reported lower SWB compared to excluded (M_{diff} = 4.43, $t(9551)$ = 2.49, p = .014). There were no significant differences in BMI.

Table 1: Characteristics for participants with missing values on alcohol units and/or alcohol frequency compared to participants with no missing on these variables

	Wave 6						Wave 7					
	Women			Men			Women			Men		
Variables	Missing (*n* = 235)	Not missing (*n* = 6 693)	*p*	Missing (*n* = 122)	Not missing (*n* = 5 931)	*p*	Missing (*n* = 219)	Not missing (*n* = 10 855)	*p*	Missing (*n* = 146)	Not missing (*n* = 9 863)	*p*
Age	68.89	57.13	< .001 [a]	68.16	57.28	< .001 [a]	66.95	57.03	< .001 [a]	65.97	57.29	< .001 [a]
(*SD*)	(12.10)	(12.81)		(11.21)	(12.24)		(12.38)	(11.34)		(12.31)	(11.33)	
Education level			< .001 [b]			< .001 [b]			< .001 [b]			<.001 [b]
Primary/secondary	63.9%	30.9%		54.3%	24.5%		49.1%	23.7%		42.6%	21.9%	
Vocational/high school	25.4%	32.0%		30.5%	35.6%		24.9%	25.4%		20.4%	30.6%	
University degree, <4 yrs	3.4%	15.3%		10.5%	20.7%		13%	17.7%		14.8%	21.3%	
University degree, ≥4 yrs	7.3%	21.7%		4.8%	19.3%		13%	33.2%		22.2%	26.1%	
Body mass index	26.79	26.56	.448 [a]	26.52	27.28	.054 [a]	27.11	26.89	.529 [a]	27.58	27.84	.439 [a]
(*SD*)	(5.01)	(4.67)		(4.29)	(3.74)		(4.46)	(4.95)		(4.08)	(4.00)	
Current smoker	28.4%	21.1%	.011 [b]	21.3%	19.3%	.601 [b]	17.3%	14.4%	.274 [b]	19.1%	13.2%	.063 [b]
Live with a spouse/partner	52.8%	69.3%	< .001 [b]	74.3%	82.2%	.039 [b]	57.2%	72.6%	< .001 [b]	73.2%	81.7%	.022 [b]
Self-rated health VAS (0-100)							69.6	76.0	< .001 [a]	75.2	76.3	.372 [a]
(*SD*)							(19.42)	(16.93)		(16.19)	(15.52)	
Subjective wellbeing (0-100)							71.4	71.1	.863 [a]	75.9	71.4	.014 [a]
(*SD*)							(24.42)	(21.31)		(19.97)	(20.10)	

Note. n = number of participants; SD = standard deviation; [a] Tested by independent samples t-test; [b] Tested by Chi-square test.

4.2 Characteristics of study participants

Basic characteristics of variables used in the main analyses is presented in Table 2. The sample from T6 (*N* = 12 624) consisted of 6 693 women (53.0%) and 5 931 men. The average age in T6 was 57.13 years (*SD* = 12.81) for women and 57.28 years (*SD* = 12.24) for men. The sample from T7 (*N* = 20 718) consisted of 10 855 women (52.4%) and 9 863 men. The average age in T7 was 57.03 years (*SD* = 11.34) for women and 57.29 years (*SD* = 11.33) for men.

In total 38.4% of the participants in T6 reported having completed education in college/university, where 19.3% of the male participants and 21.7% of the female participants had completed four years or more of college/university education. In T7 49.3% reported having completed college/university education, where 26.1% of male participants and 33.2% of female participants had completed 4 years or more. In T6 there were 27.9% in total reporting primary/secondary education to be their highest completed education (30.9% of women and 24.5% of men). In T7 22.8% reported primary/secondary education as their highest completed education (23.7% of women and 21.9% of men).

The total average alcohol intake in T6 was reported to be 2.57 units/week (*SD* = 3.77), where women reported an average of 2.00 (*SD* = 3.10) and men reported 3.21 (*SD* = 4.32) units per week. The highest reported alcohol intake was 66 units/week both for men and for women. A total of 9 216 participants (73.0%) in T6 reported to drink 3 units of alcohol or less per week (78.5% of women and 66.8% of men). 909 women (13.6%), and 1 104 men (18.6%) reported consuming above 7 to 14 units per week. 51 women (0.8%) and 145 men (2.4%) reported a consumption above 14 units weekly. In T7 the mean alcohol intake was reported to be 3.05 units per week (*SD* = 3.87), with women reporting 2.40 units (*SD* = 3.12) and men reporting 3.77 units (*SD* = 4.78). The highest reported alcohol intake per week in T7 was 66 units per week for men and 44 for women. 66.1% in total reported drinking 0-3 units/week (71.8% of women and 59.8% of men). 1 062 women (9.8%), and 1 547 men (15.7%) reported consuming >7-14 units per week. 106 women (1.0%) and 334 men (3.4%) reported a consumption above 14 units per week. The age groups reporting the highest weekly alcohol consumption were those from 30 to 59 in T6, and 50 to 69 in T7, see Appendix 4 for Bar Graph. The education group reporting the highest weekly alcohol consumption was the highest education groups both in T6 and T7, see Figure 2 and 3 below.

In T6 the average BMI was 26.56 (*SD* = 4.67) for women and 27.28 (*SD* = 3.74) for men. 58.4% of women and 71.9% of men had a BMI of 25 or higher. In T7 the average BMI for women was 26.89 (*SD* = 4.95) and 27.84 (*SD* = 4.00) for men. 59.5% of women and 75.9% of men had a BMI of 25 or higher. In T6 21.1% of women and 19.3% of men reported to be current smokers. In T7 14.4% of women and 13.2% of men were current smokers. In T6 69.3% of women and 82.2% of men reported living with a partner or spouse, in T7 this was reported by 72.6% of women and 81.7% of men. Women reported on average a slightly lower self-reported health score (*M* = 76.0, *SD* = 16.93) compared to men (*M* = 76.3, *SD* = 15.52). Also, the SWB score was slightly lower among women (*M* = 71.1, *SD* = 21.31) compared to men (*M* = 71.3, *SD* = 20.74).

For sample characteristics for participants participating in both waves (*N* = 8 884), see Supplementary Table 1.

2: Sample characteristics for the sixth (N = 12 624) and seventh (N = 20 718) wave of the Tromsø Study

	Wave 6						**Wave 7**					
	Women		Men		Total		Women		Men		Total	
Variables	*n*	*M*/%	*n*	*M*/%	*n*	*M*/%	*n*	*M*/%	*n*	*M*/%	*n*	*M*/%
Age	6 693	57.13	5 931	57.28	12 624	57.20	10 855	57.03	9 863	57.29	20 718	57.16
(*SD*)		(12.81)		(12.24)		(12.54)		(11.34)		(11.33)		(11.34)
Sex	6 693	53.0%	5 931	47.0%			10 855	52.4%	9 863	47.6%		
Education level												
Primary/secondary	2 048	30.9%	1 437	24.5%	3 485	27.9%	2 534	23.7%	2 133	21.9%	4 667	22.8%
Vocational/high school	2 118	32.0%	2 087	35.6%	4 205	33.7%	2 717	25.4%	2 975	30.6%	5 692	27.9%
University degree, <4 yrs	1 013	15.3%	1 215	20.7%	2 228	17.8%	1 895	17.7%	2 075	21.3%	3 970	19.4%
University degree, ≥4 yrs	1 439	21.7%	1 131	19.3%	2 570	20.6%	3 559	33.2%	2 540	26.1%	6 099	29.9%
Alcohol units per week	6 693	2.00	5 931	3.21	12 624	2.57	10 855	2.40	9 863	3.77	20 718	3.05
(*SD*)		(3.10)		(4.32)		(3.77)		(3.12)		(4.78)		(4.05)
[0-3]	5 252	78.5%	3 964	66.8%	9 216	73.0%	7 792	71.8%	5 903	59.8%	13 693	66.1%
(3-7]	909	13.6%	1 104	18.6%	2 013	15.9%	1 897	17.5%	2 079	21.1%	3 976	19.2%
(7-14]	481	7.2%	718	12.1%	1 199	9.5%	1062	9.8%	1547	15.7%	2609	12.6%
>14	51	0.8%	145	2.4%	196	1.6%	106	1.0%	334	3.4%	440	2.1%
Body mass index	6 678	26.56	5 927	27.28	12605	26.90	10 820	26.89	9 838	27.84	20 658	27.34
(*SD*)		(4.67)		(3.74)		(4.27)		(4.95)		(4.00)		(4.55)
<18.5	60	0.9%	15	0.3%	75	0.6%	98	0.9%	18	0.2%	116	0.6%
18.5-24.9	2 720	40.7%	1 654	27.9%	4 374	34.7%	4 262	39.4%	2 356	23.9%	6 618	32.0%
25-29.9	2 554	38.3%	3 044	51.4%	5 598	44.4%	4 021	37.0%	4 994	50.8%	9 015	43.6%
>30	1 343	20.1%	1 214	20.5%	2 557	20.3%	2 439	22.5%	2 470	25.1%	4 909	23.8%
Current smoker	1 394	21.1%	1 133	19.3%	2 527	20.3%	1 555	14.4%	1 296	13.2%	2 851	13.8%
Live with a spouse/partner	4 460	69.3%	4 794	82.2%	9 254	75.5%	7 312	72.6%	7 798	81.7%	15 110	77.0%
Self-rated health VAS (0-100)							10 640	76.0	9 689	76.3	20 329	76.2
(*SD*)								(16.93)		(15.52)		(16.27)
Subjective wellbeing (0-100)							10 235	71.1	9 428	71.4	19 663	71.3
(*SD*)								(21.31)		(20.10)		(20.74)

Note. *n* = number of subjects; *M* = mean; *SD* = standard deviation.

4.3 Confirmatory analyses

4.3.1 The social gradient in alcohol consumption

Linear regression analyses for the total alcohol intake (units per week) by education groups adjusted for possible confounders is presented in Table 3, for T6 and T7 separate and separate by sex. For a visual illustration of the reversed social gradient in total alcohol consumption, see Figures 2 and 3 below.

There was a clear reversed social gradient with individuals with the highest education having the highest total alcohol consumption. Women having completed high school or vocational school as their highest education consumed on average 0.71 units per week more than the reference group in T6 (95% CI [0.52, 0.90], $p < .001$) and 0.74 in T7 (95% CI [0.56, 0.91], $p < .001$). Women reporting a university degree less than 4 years reported on average an alcohol consumption of 0.99 weekly units higher compared to the reference group in T6 (95% CI [0.75, 1.23], $p < .001$) and 1.03 in T7 (95% CI [0.84, 1.22], $p < .001$). Women holding a university degree 4 years or more had an average alcohol consumption of 1.79 weekly units higher compared to the lowest alcohol group in T6 (95% CI [1.57, 2.01], $p < .001$) and 1.59 in T7 (95% CI [1.42, 1.76], $p < .001$).

Men having completed high school/ vocational school as their highest education reported on average an alcohol consumption of 0.55 units per week higher than the lowest education group in T6 (95% CI [0.27, 0.84], $p < .001$) and 0.81 units in T7 (95% CI [0.55 1.08], $p < .001$). Men holding a university degree less than 4 years reported an average alcohol consumption of 0.97 weekly units higher than the reference group in T6 (95% CI [0.65, 1.30], $p < .001$) and 1.36 in T7 (95% CI [1.07, 1.65], $p < .001$). Men in the highest education group reported an average alcohol consumption of 1.90 units per week higher compared to the lowest education group in T6 (95% CI [1.56, 2.24], $p < .001$) and 1.97 in T7 (95% CI [1.69, 2.25], $p < .001$).

The regression analysis both for T6 and T7, for men and women separate showed a significant p-trend ($p < .001$) and significant increase in alcohol for each education group ($p < .001$), suggesting a dose-response relationship with higher education being associated with an increased alcohol consumption.

Table 3: Linear regression analysis between education level and total alcohol intake (units/ week). Unstandardized B with 95% CI.

		Women (T6 *n* = 6 339, T7 *n* = 10 017)				**Men (T6 *n* = 5 873, T7 *n* = 9 495)**			
		Crude	**Adjusted[1]** (age)	**Adjusted[2]** (age + smoking status)	**Adjusted[3]** (age + smoking status + marital status)	**Crude**	**Adjusted[1]** (age)	**Adjusted[2]** (age + smoking status)	**Adjusted[3]** (age + smoking status + marital status)
T6 - Education	Primary/secondary	*Reference*							
	Vocational/high school	0.77*** (0.59, 0.96)	0.67*** (0.48, 0.86)	0.71*** (0.52, 0.90)	0.71*** (0.52, 0.90)	0.64*** (0.36, 0.93)	0.55*** (0.27, 0.84)	0.55*** (0.27, 0.84)	-
	University degree, <4 yrs	0.99*** (0.76, 1.22)	0.89*** (0.67, 1.14)	0.99*** (0.75, 1.23)	0.99*** (0.75, 1.23)	1.07*** (0.74, 1.39)	0.86*** (0.53, 1.18)	0.97*** (0.65, 1.30)	-
	University degree, ≥4 yrs	1.78*** (1.58, 1.99)	1.67*** (1.45, 1.88)	1.79*** (1.57, 2.01)	1.79*** (1.57, 2.01)	1.70*** (1.36, 2.04)	1.77*** (1.43, 2.10)	1.90*** (1.56, 2.24)	-
	p-trend	<.001	<.001	<.001	<.001	<.001	<.001	<.001	-
T7 - Education	Primary/secondary	*Reference*							
	Vocational/high school	0.68*** (0.51, 0.86)	0.72*** (0.54, 0.89)	0.74*** (0.57, 0.92)	0.74*** (0.56, 0.91)	0.67*** (0.41, 0.94)	0.74*** (0.47, 1.00)	0.80*** (0.54, 1.07)	0.81*** (0.55, 1.08)
	University degree, <4 yrs	0.88*** (0.69, 1.07)	0.96*** (0.77, 1.15)	1.03*** (0.84, 1.23)	1.03*** (0.84, 1.22)	1.15*** (0.86, 1.44)	1.21*** (0.92,1.50)	1.35*** (1.06, 1.64)	1.36*** (1.07, 1.65)
	University degree, ≥4 yrs	1.38*** (1.22, 1.54)	1.49*** (1.32, 1.67)	1.60*** (1.43, 1.76	1.59*** (1.42, 1.76)	1.65*** (1.38, 1.93)	1.77*** (1.49, 2.04)	1.96*** (1.68, 2.24)	1.97*** (1.69, 2.25)
	p-trend	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001

Note. ***significant on 0.1%-level ($p < .001$)

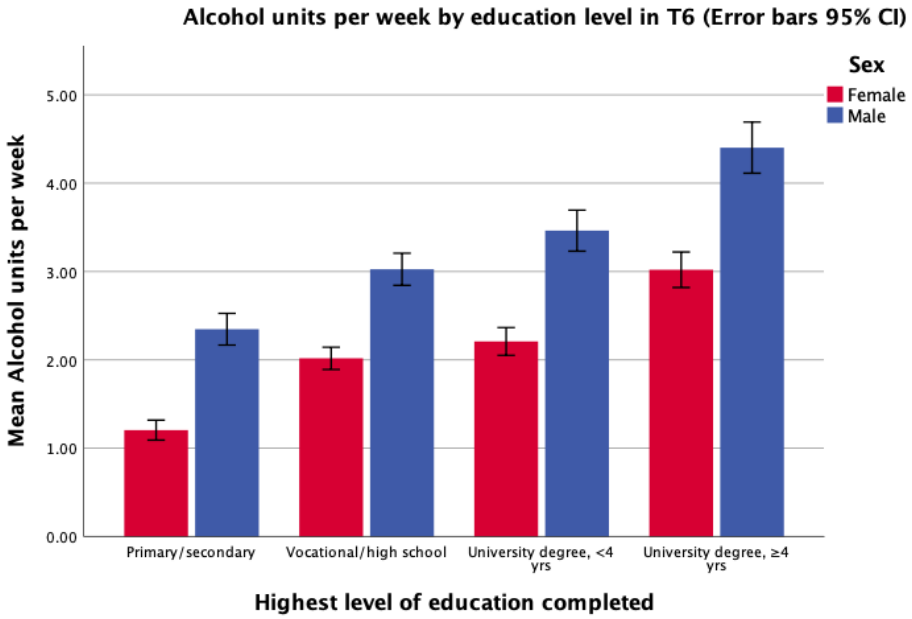

Figure 2: Bar graph - Alcohol units per week by education level in T6

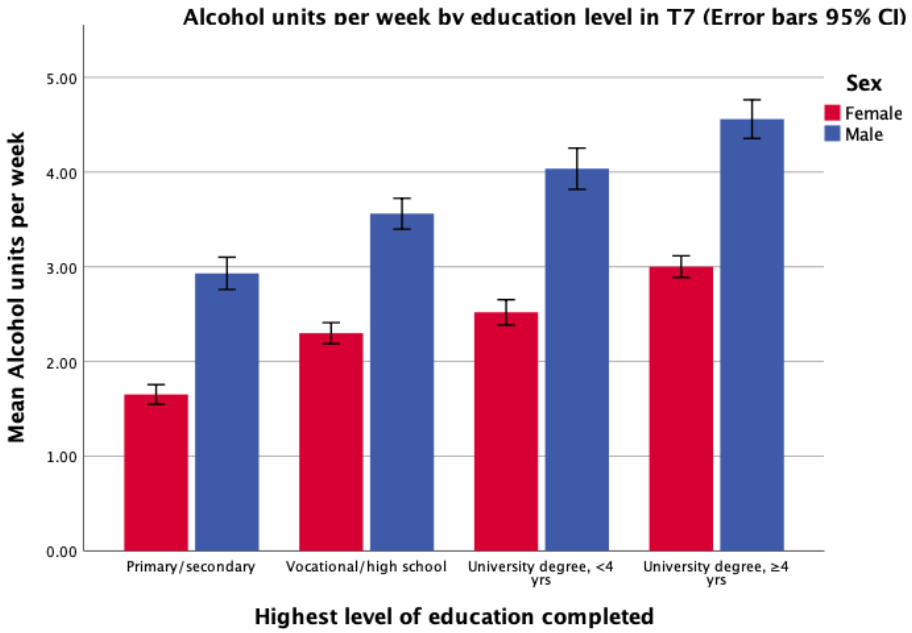

Figure 3: Bar graph - Alcohol units per week by education level in T7

There was a significant increase in alcohol intake from T6 to T7 of around 0.22 units per week for both women ($M = 0.22$, $SD = 2.63$, $t(4544) = 5.59$, $p < .001$) and men ($M = 0.22$, $SD = 3.66$, $t(4001) = 3.75$, $p < .001$). The change was not significantly different between genders, $t(8545) = 0.21$, $p = .983$.

Linear regression for the social gradient in change in alcohol consumption is presented in Table 4. There were significant differences in change in alcohol consumption between T6 and T7 for women, where those holding a university degree of less than 4 years had an increase in alcohol consumption of 0.31 units per week more than the reference group (95% CI [0.03, 0.54], $p < .05$). Women holding a university degree of 4 years or more had an increased alcohol consumption of 0.28 units/week higher than the lowest alcohol group (95% CI [0.05, 0.51], $p < .05$). The p-trend was significant ($p = .003$), indicating a dose-response relationship with women with higher education having a higher increase in alcohol consumption compared to the lowest education group. However, there were no significant differences between the two lowest education groups in women. There were no significant educational differences apparent for the change in alcohol consumption from T6 to T7 among men ($p > .120$), and the p-trend was not significant ($p = .336$).

Table 4: Linear regression analysis between education level and change in alcohol intake (units/week) from T6 to T7

		Women (*n* = 4 545)		**Men (*n* = 3 955)**		
		Crude	**Adjusted[1]** (age)	**Crude**	**Adjusted[1]** (age)	**Adjusted[2]** (age + marital status)
Education	Primary/secondary	*Reference*				
	Vocational/high school	0.11 (-0.09, 1.31)	0.00 (-0.21, 0.21)	0.12 (-0.19, 0.43)	0.07 (-0.24, 0.38)	0.06 (-0.26, 0.37)
	University degree, <4 yrs	0.47*** (0.23, 0.71)	0.31* (0.03, 0.54)	0.34 (0.00, 0.69)	0.30 (-0.05, 0.64)	0.28 (-0.07, 0.62)
	University degree, ≥4 yrs	0.45*** (0.23, 0.66)	0.28* (0.05, 0.51)	0.24 (-0.11, 0.59)	0.16 (-0.20, 0.52)	0.14 (-0.21, 0.50)
p-trend		<.001	.003	.133	.294	.336

Note. *significant on 5%-level ($p < .05$), **significant on 1%-level ($p < .01$), ***significant on 0.1%-level ($p < .001$)

4.3.2 The effect of alcohol consumption on smoking cessation

Hierarchical logistic regression was performed to assess the impact of alcohol consumption at T6 on smoking cessation from T6 to T7, see Table 5. Only individuals reporting to be smokers in T6 was included. In Table 5 *OR* and 95% CI (both crude and adjusted estimates)

are presented. Among included participants 39.9% of women and 41.5% of men reported smoking cessation from T6 to T7. None of the alcohol consumption groups were statistically significantly different from the reference group (0-3 units/week) regarding smoking cessation, and the p-trend was not significant, neither for women (p = .531), nor for men (p = .986).

Both in women and men the two highest education groups in T6 had significantly higher odds for smoking cessation compared to the lowest education groups. Among women having completed university or college education less than 4 years was associated with 73% higher odds of smoking cessation compared to the lowest education group (*OR* = 1.73, 95% CI [1.10, 2.71], p = .017), and university/college education 4 years or more was associated with 115% higher odds for smoking cessation (*OR* = 2.15, 95% CI [1.33, 3.47], p = .002). The results were similar for men, where less than 4 years was associated with 59% higher odds for smoking cessation (*OR* = 1.59, 95% CI [1.02, 2.50], p = .043), and more than 4 years was associated with 124% higher odds for smoking cessation (*OR* = 2.24, 95% CI [1.24, 4.05], p = .008), both compared to the lowest education group.

4.3.3 The effect of alcohol consumption on weight change

Hierarchical multiple regression was performed to assess the impact of alcohol consumption at T6 as a predictor for weight change from T6 to T7, see Table 5. Only participants with a BMI of 25 or higher in T6 and/or T7 was included in the analyses. Among the included participants in this analysis, women had an average weight gain of 1.47kg (*SD* = 6.87, *n* = 3 035), and men had an average weight gain of 0.90 kg (*SD* = 5.90, *n* = 3 202). None of the alcohol consumption groups were significantly different from the reference group regarding weight change when adjusting for potential confounders. The p-trend was not significant neither form women (p = .164) nor for men (p = .883).

In women there were no significant differences in weight change between the different education groups in T6 (p > .327). In men, however, completed vocational/ high school was associated with 0.56 kg less weight gain (*B* = -0.56, 95% CI [-1.09, -0.03], p = .038), completed university/college education less than 4 years was associated with 0.89 kg less weight gain (*B* = -0.89, 95% CI [-1.49, -0.29], p = .004), and university/college education 4 years or more was associated with a weight gain of almost 0.91 kg less (*B* = -0.91 95% CI [-1.55, -0.27], p = .006), all compared to the lowest education group. Being a current smoker in T6 was associated with weight gain of around 2 kg more than non-smokers both in women (*B* = 2.21 95% CI [1.59, 2.84], p < .001) and men (*B* = 1.94, 95% CI [1.39, 2.49], p < .001).

Table 5: Regression analyses for alcohol consumption in T6 as a predictor for smoking cessation (OR, 95% CI), and weight change (Unstandardized B, 95% CI), adjusted for possible confounders.

		Women (weight change *n* = 3 035, smoking cessation *n* = 852)					**Men (weight change *n* = 3 202, smoking cessation *n* = 661)**				
		Crude	**Adjusted[1]** (age)	**Adjusted[2]** (age + education)	**Adjusted[3]** (age + education + smoking)	**Adjusted[4]** (age + education + smoking + marital status)	**Crude**	**Adjusted[1]** (age)	**Adjusted[2]** (age + education)	**Adjusted[3]** (age + education + smoking)	**Adjusted[4]** (age + education + smoking + marital status)
Smoking cessation by alcohol units [a]	[0-3]	*Reference*									
	(3-7]	1.01 (0.68, 1.48)	1.01 (0.68, 1.49)	0.88 (0.59, 1.32)	-	-	0.91 (0.63, 1.32)	0.94 (0.64, 1.37)	0.90 (0.62, 1.33)	-	-
	(7-14]	1.36 (0.83, 2.23)	1.37 (0.84, 2.26)	1.17 (0.70, 1.94)	-	-	0.93 (0.56, 1.54)	0.97 (0.58, 1.61)	0.86 (0.51, 1.45)	-	-
	>14	1.92 (0.42, 8.64)	1.97 (0.44, 8.92)	1.44 (0.31, 6.71)	-	-	0.96 (0.43, 2.17)	1.02 (0.45, 2.30)	0.90 (0.39, 2.07)	-	-
p-trend		.231	.200	.531	-	-	.856	.666	.986	-	-
Weight change by alcohol units [b]	[0-3]	*Reference*									
	(3-7]	0.51 (-0.21, 1.24)	0.26 (-0-45, 0.96)	0.37 (-0.35, 1.08)	0.32 (-0.40, 1.03)	0.34 (-0.37, 1.05)	0.57* (0.04, 1.10)	0.16 (-0.36, 0.68)	0.25 (-0.27, 0.77)	0.15 (-0.37, 0.70)	0.12 (-0.40, 0.64)
	(7-14]	0.32 (-0.70, 1.33)	0.24 (-0.75, 1.23)	0.41 (-0.60, 1.41)	0.33 (-0.66, 1.32)	0.34 (-0.37, 1.05)	-0.15 (-0.79, 0.49)	-0.34 (-0.97, 0.28)	-0.13 (-0.76, 0.51)	-0.13 (-0.75, 0.50)	-0.12 (-0.75, 0.51)
	>14	-1.21 (-4.24, 1.82)	-0.77 (-3.71, 2.17)	-0.53 (-3.48, 2.42)	-0.61 (-3.54, 2.32)	-0.60 (-3.52, 2.33)	-0.16 (-1.46, 1.13)	-0.11 (-1.37, 1.16)	0.03 (-1.24, 1.29)	-0.22 (-1.47, 1.04)	-0.27 (-1.52, 0.99)
p-trend		.026	.195	.094	.200	.164	.365	.926	.688	.947	.883

Note. [a] Only participants reporting to be current smokers in T6; [b] Only participants with BMI >25 in T6 and/or T7; *significant on 5%-level ($p < .05$).

4.4 Exploratory analyses

Since hypotheses 2a) and 2b) did not hold, i.e. no associations between increased alcohol-consumption and the other two life-style variables (smoking and bodyweight), it was explored if there could be an association between change in alcohol consumption with weight change and smoking cessation. It was also explored if the lack of results on the main analyses could be because the education groups whose alcohol-consumption increase the most are the same groups who are well-informed on the health-damaging effects of smoking and overweight. Thus, moderate alcohol-consumption might be positively associated with better health-related quality of life and higher life-satisfaction.

4.4.1 The association between alcohol change and smoking cessation

A binary logistic regression was performed to assess a possible association between change in alcohol consumption and smoking cessation when adjusting for possible confounders, presented in Table 6. Only smokers in T6 were included. Among the women included in the analysis 40% reported to have quit smoking from T6 to T7. The group reporting a moderate decrease in alcohol (1 to 7 units/week decrease), had 52% higher odds for smoking cessation compared to those not changing their alcohol consumption. This difference was significant (*OR* = 1.52, 95% CI [1.01, 2.29], $p < .05$). The other groups were not significantly different from the reference group, and the p-trend was not significant ($p = .094$). For men there were no significant differences in odds for smoking cessation and the adjusted p-trend was not significant ($p = .600$).

4.4.2 The association between alcohol change and weight change

A multiple linear regression was performed to assess a possible association between change in alcohol consumption and weight change when adjusting for possible confounders, presented in Table 6. Among the included participants, men gained on average 0.93 kg (*SD* = 5.87, *n* = 3 116), and women gained on average 1.55 kg (*SD* = 6.90, *n* = 2 893). When adjusting for age, education, smoking status and marital status, there were no difference in weight change between different levels of alcohol consumption change among women. The p-trend was not significant ($p = .397$). Among men, the group reporting a large decrease in alcohol consumption (more than 7 units/week decrease), lost on average 2.26 more weight in kg compared to the reference group (-1 to +1 change in alcohol units/week), *B* = -2.26, 95% CI [-3.63, -0.90], $p < .01$. Those with a moderate decrease (1 to 7 units/week decrease) gained on average 0.57kg less compared to the reference group (*B* = -0.57, 95% CI [-1.12, -0.03], $p <$

.05). Those with a moderate or high increase in alcohol consumption was not significantly different from the reference group. However, the p-trend was significant ($p < .001$), suggesting a dose-response relationship with men with decreasing alcohol consumption being associated with weight loss and increasing alcohol consumption possibly being associated with weight gain.

Table 6: Regression analysis for change in alcohol consumption from T6 to T7 as a predictor for smoking cessation (OR, 95% CI), and weight change (Unstandardized B, 95% CI), adjusted for possible confounders. (EXPLORATORY PART)

		Women (weight change *n* = 3 035, smoking cessation *n* = 828)					**Men (weight change *n* = 3 202, smoking cessation *n* = 646)**				
		Crude	**Adjusted[1]** (age)	**Adjusted[2]** (age + education)	**Adjusted[3]** (age + education + smoking)	**Adjusted[4]** (age + education + smoking + marital status)	**Crude**	**Adjusted[1]** (age)	**Adjusted[2]** (age + education)	**Adjusted[3]** (age + education + smoking)	**Adjusted[4]** (age + education + smoking + marital status)
Smoking cessation by alcohol units change [a]	Large decrease	1.81 (0.60, 5.45)	1.96 (0.65, 5.95)	1.72 (0.55, 5.33)	-	-	1.20 (0.51, 2.84)	1.19 (0.50, 2.85)	1.11 (0.46, 2.66)	-	-
	Moderate decrease	1.52* (1.02, 2.27)	1.55* (1.04, 2.33)	1.52* (1.01, 2.29)	-	-	0.84 (0.56, 1.27)	0.85 (0.56, 0.1.28)	0.85 (0.56, 1.28)	-	-
	No change	*Reference*									
	Moderate increase	1.36 (0.94, 1.98)	1.37 (0.94, 2.00)	1.29 (0.88, 1.90)	-	-	0.81 (0.54, 1.23)	0.83 (0.55, 1.27)	0.86 (0.56, 1.31)	-	-
	Large increase	0.39 (0.13, 1.17)	0.41 (0.14, 1.26)	0.35 (0.11, 1.07)	-	-	1.41 (0.71, 2.79)	1.47 (0.74, 2.91)	1.39 (0.70, 2.79)	-	-
p-trend		.150	.137	.094	-	-	.745	.646	.600	-	-
Weight change by alcohol units change [b]	Large decrease	-0.42 (-3.12, 2.29)	-0.30 (-2.93, 2.33)	-0.15 (-2.79, 2.48)	-0.42 (-3.03, 2.20)	-0.43 (-3.04, 2.18)	-1.73* (-3.14, -0.31)	-2.07** (-3.45, -0.69)	-2.05** (-3.43, -0.67)	-2.19** (-3.56, -0.82)	-2.26** (-3.63, -0.90)
	Moderate decrease	1.42*** (0.61, 2.23)	0.98* (0.19, 1.77)	1.00* (0.21, 1.80)	0.80* (0.01, 1.58)	0.76 (-0.02, 1.55)	0.02 (-0.54, .58)	-0.45 (-1.00, 0.10)	-0.46 (-1.01, 0.09)	-0.54 (-1.09, 0.00)	-0.57* (-1.12, -0.03)
	No change	*Reference*									
	Moderate increase	0.72* (0.03, 1.46)	0.01 (-0.70, 0.71)	0.06 (-0.65, 0.76)	-0.2 (-0.72, 0.68)	0.00 (-0.70, 0.70)	0.63* (0.08, 1.18)	0.06 (-0.48, 0.61)	0.08 (-0.47, 0.62)	0.06 (-0.48, 0.59)	0.05 (-0.48, 0.59)
	Large increase	0.93 (-1.05, 2.91)	0.10 (-1.84, 2.03)	0.23 (-1.71, 2.17)	0.05 (-1.87, 1.97)	0.08 (-1.84, 2.00)	1.78** (0.67, 2.89)	1.19* (0.10, 2.27)	1.25* (0.17, 2.33)	1.06 (-0.02, 2.13)	1.07 (-0.01, 2.14)
p-trend		.966	.279	.319	.345	.397	<.001	<.001	<.001	<.001	<.001

Note. [a] Only participants reporting to be current smokers in T6; [b] Only participants with BMI >25 in T6 and/or T7; Large decrease = >7 units decrease; Moderate decrease = 1-7 units decrease; No change = 0.99 units decrease to 0.99 units increase; Moderate increase = 1-7 units increase; Large increase = >7 units increase; *significant on 5%-level ($p < .05$), **significant on 1%-level ($p < .01$).

4.4.3 Health-related characteristics across levels of alcohol intake

Percent of smokers, average BMI, self-rated health and SWB across different levels of alcohol consumption in T7 were descriptively explored (Table 7). Among women in the lowest alcohol group, 14.4% reported to be smokers, the average BMI was 27.31 (*SD* = 5.14), the average self-rated health on a 0-100 scale was 74.70 (*SD* = 17.48), and the average SWB was 70.29 (*SD* = 21.65). Among women consuming >3 to 7 units per week 13.2% reported to be smokers, the average BMI was 25.77 (*SD* = 4.27) the average self-rated health was 79.09 (*SD* = 15.51) and average SWB was 73.08 (*SD* = 20.27). In women consuming >7 to 14 units per week 15.3% were smokers, average BMI was 25.89 (*SD* = 4.19), average self-reported health was 79.6 (*SD* = 13.89) and SWB was 73.3 (*SD* = 20.09). In the highest alcohol group (>14 units/weekly) 30.5% were smokers, the average BMI was 26.09 (*SD* = 4.39), average self-rated health was 75.9 (*SD* = 16.17) and average SWB was 70.2 (*SD* = 23.23). The groups were significantly different from each other on all the reported health-related characteristics ($p < .001$).

Among men in the lowest alcohol group 12.5% reported to be smokers, the average BMI was 28.03 (*SD* = 4.14), the average self-rated health was 75.7 (*SD* = 16.07), and the average SWB was 71.4 (*SD* = 20.05). Among men consuming >3 to 7 units per week 13.6% reported to be smokers, the average BMI was 27.62 (*SD* = 3.86), the average self-rated health was 77.8 (*SD* = 14.65) and average SWB was 72.0 (*SD* = 19.33). In men consuming >7 to 14 units per week 12.7% were smokers, average BMI was 27.40 (*SD* = 3.63), average self-reported health was 77.5 (*SD* = 14.30) and SWB was 72.1 (*SD* = 19.21). In the highest alcohol group (>14 units/weekly) 25.3% of men were smokers, the average BMI was 28.03 (*SD* = 3.95), average self-rated health was 73.4 (*SD* = 15.32) and average SWB was 65.1 (*SD* = 23.43). The groups were significantly different from each other on all the reported health-related characteristics ($p < .001$).

Among both men and women, the group of particular interest (>7-14 units/week) seemed to be the healthiest regarding both BMI, self-rated health and SWB. Among men, this group was also the group with fewest smokers after the lowest alcohol group and the group with the lowest BMI. Based on this, there does not seem to be reason for concern for this group being in worse health compared to those with a lower consumption – rather the other way around. These numbers are, however, not adjusted for possible confounders and it is likely that characteristics such as age and education could partly be mediating this relationship.

Table 7: Percent of smokers, average BMI, self-rated health and subjective well-being (SWB) across different levels of alcohol consumption in T7. (EXPLORATORY PART)

	Women									**Men**								
	[0-3] units per week		(3-7] units per week		(7-14] units per week		>14 units per week			[0-3] units per week		(3-7] units per week		(7-14] units per week		>14 units per week		
	n	*M(SD)*/%	*n*	*M(SD)*/%	*n*	*M(SD)*/%	*n*	*M(SD)*/%	*p*	*n*	*M(SD)*/%	*n*	*M(SD)*/%	*n*	*M(SD)*/%	*n*	*M(SD)*/%	*p*
% Smokers	1 111	14.4%	250	13.2%	162	15.3%	32	30.5%	< .001 [b]	735	12.5%	282	13.6%	195	12.7%	84	25.3%	< .001 [b]
BMI	7 763	27.31 (5.14)	1 893	25.77 (4.27)	1 058	25.89 (4.19)	106	26.09 (4.39)	< .001 [a]	5 882	28.03 (4.14)	2 076	27.62 (3.86)	1 547	27.40 (3.63)	333	28.03 (3.95)	< .001 [a]
Self-rated health	7 606	74.7 (17.48)	1 876	79.1 (15.51)	1 054	79.6 (13.89)	104	75.9 (16.17)	< .001 [a]	5 771	75.7 (16.07)	2 058	77.8 (14.65)	1 530	77.5 (14.30)	330	73.4 (15.32)	< .001 [a]
SWB	7 268	70.3 (21.65)	1 833	73.1 (20.27)	1 034	73.3 (20.09)	100	70.2 (23.23)	< .001 [a]	5 578	71.4 (20.35)	2 017	72.0 (19.33)	1 509	72.1 (19.21)	324	65.1 (23.43)	< .001 [a]

Note. *n* = number of participants; *M* = mean; *SD* = standard deviation; [a] Tested by one-way ANOVA; [b] Tested by Chi-square test.

5 Discussion

5.1 Summary of results

The primary aim of the present study was 1) to examine the extent of inequalities in total alcohol consumption across educational groups, and 2) to explore the relationship between high alcohol consumption and the lifestyle risk factors smoking and weight.

This study found a clear reversed social gradient in alcohol consumption, where the higher alcohol consumption was *positively* associated with higher education. The total alcohol consumption increased from T6 to T7, and the increase has been the same (average increase of 0.22 units/week) in both women and men. Women with college/university education have had a significantly higher increase in alcohol from T6 to T7 compared to women in the lowest education group. This was not observed among men.

Surprisingly, alcohol consumption at T6 was not associated with smoking cessation, nor was it associated with weight change among individuals reporting BMI above 25 kg/m^2 in T6 and/or T7. There were few individuals with data on smoking cessation (women n = 852, men n = 661) and few of these reporting an alcohol consumption above 14 units weekly (women n = 7, men n = 26). With a sample consisting of more individuals with data on smoking cessation in each alcohol group, the results may have been different.

Education was positively associated with higher frequency of smoking cessation among both sexes and negatively associated with weight gain among men, indicating that higher SES is related to healthier behavioral changes regarding smoking and weight.

In exploratory analyses it was found an association between change in alcohol consumption and weight change in men, with those decreasing their alcohol consumption gaining less weight compared to those maintaining their alcohol consumption. This trend was not found in women, where there were no significant differences between different levels of change in alcohol consumption. It was found that women decreasing their alcohol consumption moderately had 52 % higher odds of smoking cessation compared to those maintaining their alcohol consumption. There was no difference in odds for smoking cessation between different levels of alcohol change among men. When briefly assessing health-related characteristics across different alcohol consumption groups, it was not found any reason for concern for the health and well-being of the group consuming 7 to 14 units of alcohol weekly.

This study found support for hypothesis 1 a) "total alcohol consumption in units per week is different across different educational groups in T6 and T7 separately", where higher educational attainment was associated with a higher total alcohol intake. The results support hypothesis 1 b) "there is a social gradient in the change in alcohol consumption from T6 to T7 for individuals participating in both waves", only in women - where women with higher educational attainment increased their alcohol consumption more compared to those with lower educational attainment. The results in this study does *not* support hypothesis 2 a) "there is an association between alcohol consumption in T6 and smoking cessation from T6 to T7" or 2 b) "There is an association between alcohol consumption in T6 and weight change from T6 to T7".

5.2 Strengths and limitations

5.2.1 Strengths

The main strength of this study is the large number of participants and the high attendance rate of 66% in T6 (Eggen et al., 2013) and 65% in T7 (University of Tromsø, n. d.-b). The Tromsø 6 study was validated, and the education level among those attending was slightly higher than the general population in Tromsø and Norway. The external validity is considered to be sufficient and the study population is valid for a Northern European urban, white population (Eggen et al., 2013). Another strength of this study is the use of both the sixth and the seventh wave of the Tromsø Study and the use of change variables for certain analyses, instead of a cross-sectional design. If there were any significant findings on the main analyses, this would have made it possible to assume a high or moderate level of alcohol consumption being present before the smoking cessation or weight change.

5.2.2 Bias

Mainly two types of errors may occur in epidemiological research - systematic and random errors (Bhopal, 2016). Systematic errors (bias) affects the groups being compared in the study unequally and is a result of the method chosen by the researchers. Random error affects the reliability of the measurement and the precision of the estimate.

5.2.2.1 Selection bias

Selection bias occurs when the controls are not representative of the population where the cases are drawn from, i.e. individuals have different probabilities of being included in the study as a result of relevant study characteristics (Bhopal, 2016).

32.5% of the selected respondents in T6 and 35.3% in T7 chose not to participate. This may introduce non-response bias, which is a type of selection bias where people not attending are systematically different from those attending the study. People attending epidemiological studies generally tend to be healthier than non-attendees (Silva Junior, Santos, Coeli, & Carvalho, 2015). In the sixth wave of the Tromsø Study the participation rates were lowest for individuals invited for the first time, the youngest and the oldest, and lower among men compared to women. In addition there was a slight overrepresentation of individuals with higher education (Eggen et al., 2013). Also participants in other Norwegian population studies tend to be female, healthier and participate in better health-related behaviors compared to those not attending (Langhammer, Krokstad, Romundstad, Heggland, & Holmen, 2012; Søgaard, Selmer, Bjertness, & Thelle, 2004). It can therefore be reason to assume that the attendance rate might be lower among the heaviest drinkers because they have a higher risk of being ill (Roerecke & Rehm, 2014).

Participants with missing information on alcohol units or frequency had to be excluded from this study. The included participants in this study were younger, had more education and higher percentage reporting to live with a spouse compared to the excluded participants. This study may therefore not be representative for the general population.

5.2.2.2 Information bias

Information bias (also called measurement bias and observation bias) refers to a flaw in measuring exposure, covariate or outcome variables resulting in different accuracy of information between the groups being compared (Porta, 2014). Information bias involves misclassification, either differential (the probability of individuals being misclassified is not equal across study groups) or non-differential (the probability of individuals being misclassified is equal across all groups in the study). Differential misclassification is non-random and can cause bias either towards or away from the null hypothesis, while non-differential misclassification is random and often produces bias towards the null. A type of information bias that is common in epidemiological studies is recall bias (Bhopal, 2016). Recall bias occurs when participants are unable to recall the event of interest correctly. This can lead to imprecise results. It can be non-differential if all participants have the same problems with recalling the event, and differential if one group has more difficulties than the other group.

Information regarding health-related behaviors is self-reported in this study, with the only exception being weight and height. Self-reporting of such behaviors can be prone to bias. Self-reported alcohol intake can differ to a great extent between different measurement tools, sex and SES-groups (Kydd & Connor, 2015), but can also be a reliable and valid approach (Del Boca & Darkes, 2003) and enables large samples and non-invasive methods. A previous study from Svalbard (also in Northern Norway) suggests under-reporting of alcohol consumption (Höyer, Nilssen, Brenn, & Schirmer, 1996). Other studies suggests a tendency of such under-reporting as well (Davis, Thake, & Vilhena, 2010; Stockwell et al., 2004; Stockwell, Zhao, Chikritzhs, & Greenfield, 2008). If such an underreporting is unequal across the study groups, this could lead to differential misclassification.

Women, individuals with higher BMI, individuals with lower SES and smokers have been found to underreport intake of different foods (Johnson, Kerr, & Schap, 2017). It seems that especially groups with need for social acceptance have a higher tendency to underreport "sinful" behavior (Johnson et al., 2017), thus it is reasonable to assume that the lower SES groups (with higher prevalence of smokers, higher BMI, and worse self-reported health, see Supplementary Table 2) could also have a tendency to underreport alcohol consumption. Especially heavy episodic drinking is likely to be associated with stigma (Del Boca & Darkes, 2003), and it is therefore possible that participants with this drinking pattern have a higher tendency to underreport their alcohol consumption, leading to differential misclassification.

The "Yesterday-method", involving detailed questions of beverage types and serving sizes of alcohol drinks consumed the day before the interview, seems to be a more reliable way of measuring alcohol consumption by means of self-report (Stockwell et al., 2008). It is, however, difficult to know if this would also be a good method for measuring alcohol consumption in a population with such high prevalence of binge drinking as Norway. Since the alcohol consumption at one time point might not be representative for the rest of the year (e.g. people tend to drink more around holidays) it could perhaps be better approach measuring it at regular intervals or by daily/weekly journal, or by wearing transdermal alcohol sensors detecting alcohol eliminated through the skin (Piasecki, 2019). However, this would involve more time and efforts and would most likely result in a lower sample size.

5.2.2.3 Confounding factors

A confounder is associated with the exposure in addition to being associated with the outcome, and is not in the causal pathway between exposure and outcome (Bhopal, 2016). In

this study all analyses were done separate for sexes. Age, education, smoking status and marital status was controlled for (when appropriate) since they are well-documented confounders. There could, however, be other possible confounders not taken into account in this study.

5.2.3 Other limitations

The regression analyses assessing a social gradient in alcohol consumption and the explorative analyses for the association between change in alcohol consumption and smoking cessation and weight change, are cross-sectional - meaning that they are done at a single point in time. A limitation with cross-sectional design is that it gives no information about the direction of the relationship (Bhopal, 2016) – for example whether decrease in alcohol is affecting the tendency to stop smoking in women or if it is the smoking cessation that is affecting the reduction in alcohol consumption. For the main analyses this would not be a problem since the alcohol consumption was recorded before the change in smoking and weight. However, there were no significant results for these analyses.

Another limitation in this study is that only alcohol in units per week is included and that drinking pattern is not. Binge drinking is often said to be the most harmful alcohol consumption (Norwegian Directorate of Health, 2016), and it is not necessarily a clear association between total alcohol consumption and drinking pattern. Also, there are studies suggesting that different kinds of alcohol are more harmful/beneficial than others (Artero et al., 2015; Grønbæk et al., 2000; Hansen-Krone et al., 2011) and this is not taken into account in this study. Furthermore, diet and physical activity which are commonly included as health-related behaviors (Loef & Walach, 2012), are not included in this study.

While education is a commonly used measure for SES (Adler et al., 1994), different SES indicators may capture different aspects of overall health (Duncan et al., 2002). Other SES indicators such as income and occupation, as well as education and income of other family members, could have been included in order to achieve a more encompassing measure. One advantage with using education is perhaps that it is established relatively early in life and it is relatively stable over the adult lifespan. Since education is used as a measure for SES in the present study, it was decided that the widely used term “social gradient” should be used. It could be argued that it would be more correct to refer to an “education gradient” in this thesis. Another problem with the education variable is that some participants seems to have reduced their level of completed education. There were five alternatives for education groups in Q1 in

T6, and only 4 in Q1 in T7, where the education levels corresponding to the second and the third groups in T6 were both supposed to belong in the second education group in T7. Among the individuals participating in both waves (see Supplementary Table 1), there are more individuals reporting only completed high school in T7 (30.7%) compared to T6 (24.8%). While it is possible to increase the highest level of completed education between the two waves, it is impossible to reduce it.

The present study included complete-case analyses, meaning that only subjects with non-missing data on included variables were included. This approach can result in a reduction in sample size and thereby lead to lower precision. Moreover, it can be a source of bias if the subjects with complete data differ from those with missing data – indicating that the cases are not missing completely at random (MCAR) (White & Carlin, 2010). An alternative could be multiple imputation (MI), which also has its disadvantages when data is not MCAR (White & Carlin, 2010). When few cases have missing values, complete-case analysis is considered acceptable (Pigott, 2001). In this study MI was not deemed necessary.

The associations between change in alcohol consumption and smoking cessation in women and weight change in men, was explored without stating it beforehand. A problem with results from exploratory analyses is that if the researcher run enough analyses, he/she will, most likely, at some point find a significant result as due to chance alone. However, exploratory research can be an important way of gaining knowledge and developing new hypotheses or extending already existing theories (Jaeger & Halliday, 1998).

5.3 Interpretation

5.3.1 Social gradient in total alcohol consumption

Similar to previous studies (Adler et al., 1994; Horverak & Bye, 2007; Osler et al., 2001; Peña et al., 2017; Strand & Steiro, 2003) this study also shows reversed social gradient in alcohol consumption, where higher education is associated with a higher total alcohol consumption. Besides alcohol consumption, individuals with higher education exhibit better health behaviors compared to lower social stratums in Norway (Norwegian Directorate of Health, 2016). The present study also shows an increase in total self-reported alcohol consumption from 2007 to 2015, contrary to the numbers from Statistics Norway (2019a) which indicate a decrease in the recorded alcohol per capita consumption in liters of pure ethanol. The explanation for this may be that the total alcohol consumption is declining in

adolescents and young adults (Norwegian Institute of Public Health, 2018b), and the Tromsø Study includes participants age 30+ in T6 and 40+ in T7. As discussed, it is also possible that the self-reported alcohol is not a good measure for actual consumption, or that the recorded alcohol sales are not reflecting the consumption. The average increase among both women and men was 0.22 units per week. There is a great spread in the alcohol change from 2007 to 2015 both in women (*SD* = 2.63) and men (*SD* = 3.66). If there really is an increase in alcohol consumption in some population groups, either in certain age-groups, parts of the country or education groups, this could lead to an increase in alcohol related harms in those groups, which is the opposite of the global NCD-targets of a 10 percent reduction of the harmful alcohol consumption by 2025.

It seems that there is a different attitude towards alcohol than to other health-related behaviors (for a descriptive overview of the educational differences in smoking, BMI, self-reported health and subjective wellbeing (SWB), separate for men and women in T7, see Supplementary Table 2). While there was no educational difference in change in alcohol consumption among men, there was significant increase in alcohol consumption in women in the highest educational groups compared to the lowest educational group. If these differences keep increasing, this could be a possible public health challenge in the future.

Age is positively associated with drinking frequency (Norwegian Institute of Public Health, 2018a; Skogen et al., 2019). I Norway alcohol is mostly consumed during social gatherings and parties, and is an accepted part of the culture in the Norwegian society (Garvey, 2005). Perhaps the higher educated women increase their economic standard of living with age and participate more frequently in social gatherings where they enjoy alcohol as a result of increased social capital. This could explain why they are increasing their alcohol consumption over time. However, men still have a much higher alcohol consumption compared to women in all age and educational groups (Skogen et al., 2019). Also episodic high alcohol consumption is most prevalent in the younger age groups and among men (Skogen et al., 2019). This could mean that educated women, in fact, do not increase the most harmful alcohol consumption (or to a level that is harmful), and further that this might not be a public health challenge. According to Mackenbach et al. (2015) the alcohol-related mortality is increasing more in lower SES-groups compared to the those with higher SES in Northern European Countries.

5.3.2 Health related behaviors

5.3.2.1 Alcohol and smoking cessation

It has been implied that the main mechanism for the cooccurrence of alcohol consumption and smoking is that alcohol consumption increases the likelihood of smoking behavior (Dermody & Hendershot, 2017; Field et al., 2005; McKee et al., 2006). Past hour alcohol intake has been shown to be associated with cigarette craving and thereby increasing the risk of smoking and relapse to smoking (Tomko et al., 2017). High-risk drinkers have been found to have more difficulties quitting tobacco smoking compared to low-risk drinkers (Sells, Waters, & MacLean, 2017). However, no association between alcohol intake at T6 and smoking cessation was found in this study. The reason for this could be that there really are other underlying factors mediating this relationship. Similar to results from deRuiter, Cairney, Leatherdale, and Faulkner (2014), the present study also found an association between a moderate decrease in alcohol consumption and higher odds of smoking cessation, but only in women. This indicates that at least in women, these two behaviors may happen simultaneously, and that there possibly are other underlying mechanisms mediating this relationship. It could also be that it is the smoking cessation that is affecting the change in alcohol intake. There was data regarding smoking cessation for 1471 participants, since smoking cessation could be based on only those participating in both waves and reporting to be current smokers in T6. Of these, a total of 515 participants quit smoking from T6 to T7, including more women (n = 293) than men (n = 222). This relatively low number contributed to low precision in the estimates and could be part of the reason why no such result was found in men. In addition, it has been suggested that smoking cessation is associated with increased alcohol intake (Carmelli et al., 1993), decreased alcohol intake (Berg et al., 2015) and that there is no association (Kahler et al., 2010). If all these directions of associations between smoking cessation and alcohol change can be apparent in different individuals, this would explain the low precision and lack of consistency in the results.

5.3.2.2 Alcohol and weight change

Alcohol contains calories and has been shown to increase food intake (Yeomans, 2010) and several studies have found an association between high alcohol consumption and weight change (see detailed review in Sayon-Orea et al., 2011). In a prospective cohort study by Mozaffarian, Hao, Rimm, Willett, and Hu (2011) it was found that increases in alcohol consumption were positively associated with weight gain (0.19 kg increase per additional unit

per day). Nevertheless, MacInnis et al. (2014) found an inverse association between the two, meaning that alcohol consumption seemingly had a protective effect against weight gain. Similar to several other studies (Sayon-Orea et al., 2011) alcohol consumption could not predict weight change in the present study. Many of the studies that have found a positive association between alcohol intake and weight gain, have found such an association with high alcohol consumption only (Sayon-Orea et al., 2011). There were few participants reporting a consumption of more than 14 units per week in the sixth wave of the Tromsø Study, and this could be the reason why no association could be found in the present study. In this sample BMI was highest in the group with the lowest alcohol consumption (Table 8, crude numbers not adjusted for age and education). The lack of findings could possibly be due to a possible underreporting of alcohol consumption among individuals with a high alcohol intake.

The association between change in alcohol consumption and weight change in men might indicate that these behaviors happen at the same time, at least in men, and that there possibly are other underlying mechanisms affecting both alcohol intake and weight. It could perhaps be that the men deciding to change their unhealthy habits and lead a healthier life decide to both reduce their alcohol intake and at the same time eat healthier and exercise more. It is also possible that weight change is affecting alcohol intake, but intuitively this seems less likely. An association between decrease in alcohol and less weight gain was found in men only. This may perhaps be because they often drink different types of alcoholic beverages (typically beer) containing more calories per unit than the types typically consumed by women, who often drink more wine (Norwegian Institute of Public Health, 2018a).

5.3.2.3 Group specific behaviors

The group with the highest level of education which also had the highest alcohol consumption, seems to be those who live relatively healthier in that they had a higher tendency to quit smoking and gained less weight. This indicates group specific behaviors and imply that people have a different relationship towards alcohol compared to other health related behaviors. This is also apparent in the descriptive overview showing the percent of smokers, percent having completed university education and mean self-rated health and SWB by clustering of alcohol, BMI and smoking (Supplementary Tables 3 and 4). Among females, the group with higher percentage of completed college/university education, was the overweight non-smokers with a high alcohol consumption. Among males, the highest percentage of completed college/ university education, was in normal-weight non-smokers with a high alcohol consumption. Self-rated health and SWB was better in non-smokers. Both

in men and women, the group with the highest self-rated health and SWB was normal-weight nonsmokers with a moderate alcohol consumption. Hence, the reason for the lack of association between high alcohol consumption and smoking cessation is perhaps that the highly educated are well informed on smoking and have quit that habit, but at the same time increase or maintain their drinking habits. These behaviors could be unrelated, supporting the idea that there are different attitudes towards alcohol than towards other health related behaviors.

5.3.2.4 Total alcohol consumption

One of the main limitations is the various drinking patterns, types of alcohol and other differences hiding behind the total amount consumed. There are several possible explanations to why higher SES-groups seem to experience less harms and more benefits from alcohol than those with lower SES. Perhaps the more educated are more resilient and have the resources not to experience the negative effects and only the positive effects of alcohol, or that they are participating in so many other healthy activities that a moderate to high alcohol intake does not have a negative impact. It is also possible that they exhibit healthier drinking patterns, drink healthier alcoholic beverages or that they start drinking at a later age compared to the less educated (Bellis et al., 2016). People have different consumptions mainly due to income, prices or other constraints, because of different beliefs about the impact of different actions, or as a result of different taste. It has been suggested that knowledge and cognitive ability could account for a high percentage of the education gradient in health-related behaviors (Cutler & Lleras-Muney, 2010). Apparently, this does not apply to total alcohol consumption. Still, the uncertainty about what is really mediating the relationship between education, health related behaviors and health, remains. Perhaps there are some genetic or environmental underlying factors leading to group specific habits. Furthermore, education itself may be a product of genes or early childhood environment.

In the Tromsø Study, and in Norway in general, few individuals are reporting a high alcohol consumption (above 14 units weekly). Recommendations regarding alcohol intake are not consistent between countries, and there is no clear international agreement that 14 to 21 units should be considered unhealthy (Kalinowski & Humphreys, 2016). In the group consuming more than 14 units per week, there could be two heterogeneous groups – possibly those with high educational attainment consuming just above 14 units (relatively healthy) and those with lower educational attainment consuming up to 66 units per week. If this is the case, it could

be a part of the explanation to why the higher SES-groups on average drink more, but still the lower SES-groups experience more alcohol-related harms.

Alcohol-related mortality seems to increase in lower SES-groups in several countries in Northern and Eastern Europe, but not in France, Switzerland, Spain and Italy. Mackenbach et al. (2015) argue that this may be because of the different cultures for drinking pattern and type of alcohol consumed. The countries without this socially differentiated increase in mortality have a culture for drinking higher quality alcohol as opposed to some Eastern-European countries where lower SES-groups are more frequently exposed to home-brewed and non-beverage alcohol containing toxic compounds. High episodic alcohol intake is also more prevalent in Northern and Eastern Europe, whereas Southern Europe have a culture for daily drinking, mostly wine with meals, and an absence of binge drinking (Mackenbach et al., 2015; World Health Organization, 2018).

While it is possible that the lower education groups systematically underreport their total alcohol consumption, it is unlikely that this is the whole explanation, since a wide range of studies have found a clear reversed social gradient with higher SES being associated with higher alcohol consumption (Horverak & Bye, 2007; Knupfer, 1989; Marmot, 1997; Norwegian Directorate of Health, 2016; Osler et al., 2001; Peña et al., 2017; Strand & Steiro, 2003). Although the evidence is inconclusive regarding the relationship between SES and episodic high alcohol consumption (Norwegian Directorate of Health, 2016). Some studies have indicated that lower SES-groups have a higher tendency of binge drinking than higher SES-groups (Cutler & Lleras-Muney, 2010; van Oers et al., 1999), and it is possible that different drinking patterns are also hiding within each alcohol group in this study. It could be that, while having a lower total alcohol consumption, those with lower educational attainment also have a higher rate of binge drinking – meaning that lower SES groups drink less frequently but drink a lot when they drink, leading to intoxication. If drinking pattern is more harmful than the total alcohol consumption itself, this could explain why the lower SES-groups are experiencing more alcohol-related harms than those with higher social status.

In summary, the individuals typically having a high alcohol consumption also have higher educational attainment. Higher social stratums exhibit better health-related behaviors besides alcohol. The same high-SES group is also less vulnerable to alcohol-related problems and harms. It possible that the real harm is in the drinking pattern, types and quality of alcohol

consumed, age when starting to drink, the combination with other health-related behaviors – or perhaps most likely, a combination of all the above, including total alcohol consumption.

5.4 Implications and generalizability

The external validity of The Tromsø Study is considered to be sufficient and the study population is valid for a Northern European urban, white population (Eggen et al., 2013). The included participants in this study was younger, had more education and a higher percentage reporting to live with their spouse compared to the excluded participants, meaning that the generalizability is perhaps limited.

The present study can contribute by supporting the large amount of studies indicating a reversed social gradient in total alcohol consumption. In addition, it addresses an increase in the educational differences in total alcohol intake in women, which may or may not be a future health challenge. It also indicates that higher educational attainment is associated with healthier behavioral changes, which is important in order to initiate future public health interventions targeting the most vulnerable groups.

The results in the present study indicating that total alcohol consumption cannot predict weight change and smoking cessation, can be important for generating further hypotheses for exploring the association between alcohol consumption and other health-related behaviors further. The results in this study can also be important in order to generate hypotheses regarding the association between change in alcohol consumption with smoking cessation, weight change and other health related behaviors, and whether there really are gender differences as found in the present study.

A better understanding about the role of alcohol consumption in relation to education, health-related behaviors, health and well-being is important in order to reach the SDGs, both in Norway and in the rest of the world. Because of the variations in drinking patterns, types of beverages consumed, and the age when individuals start drinking between countries and cultures, studies regarding alcohol consumption is not necessarily easily generalized. Studies of specific population groups like the Tromsø study can be important in order to understand such cultural differences and to develop interventions for targeting specific population groups.

6 Conclusion

As indicated by the results of this study there is a reversed social gradient in total alcohol consumption both for men and women, and for women only these differences have increased. There seems to be an association between a decrease in alcohol consumption and weight loss in men, and higher odds for smoking cessation in women. Total alcohol consumption does not seem to be associated with smoking cessation or weight change, while higher educational attainment was significantly associated with healthier behavioral changes in smoking for both sexes and weight change among men. This means that while those with higher educational attainment have a higher alcohol consumption, they at the same time improve towards better health related behaviors by to a higher degree quitting smoking and to a lesser degree increasing their weight compared to the less educated.

The cooccurrence of alcohol with smoking and overweight is not yet fully understood, and total alcohol consumption may not be the most important factor for understanding the link between alcohol intake and other health related behaviors. For a more nuanced picture, drinking pattern, type of alcoholic beverage and other factors should be taken into account in future research exploring the association between alcohol consumption with smoking cessation and weight change.

7 References

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8 Supplementary tables

Supplementary Table 1: Sample characteristics from T6 and T7 for participants attending both the sixth and seventh wave of the Tromsø Study (N = 8 884)

	Wave 6						Wave 7					
	Women		Men		Total		Women		Men		Total	
Variables	*n*	*M*/%	*n*	*M*/%	*n*	*M*/%	*n*	*M*/%	*n*	*M*/%	*n*	*M*/%
Age	4 762	55.51	4 122	56.10	8 884	55.78	4 762	63.51	4 122	64.10	8 884	63.78
(*SD*)		(11.33)		(11.09)		(11.22)		(11.33)		(11.09)		(11.22)
Sex	4 762	53.6%	4 122	46.4%								
Education level												
Primary/secondary	1 299	27.6%	886	21.7%	2 185	24.8%	1 552	33.5%	1 098	27.4%	2 650	30.7%
Vocational/high school	1 530	32.5%	1 486	36.4%	3 016	34.3%	1 199	25.9%	1 241	30.9%	2 440	28.2%
University degree, <4 yrs	777	16.5%	888	21.7%	1 665	18.9%	730	15.8%	833	20.8%	1 563	18.1%
University degree, ≥4 yrs	1 108	23.5%	825	20.2%	1 933	22.0%	1 153	24.9%	838	20.9%	1 990	23.0%
Alcohol units per week	4 659	2.14	4 075	3.34	8 734	2.70	4 648	2.36	4 049	3.55	8 697	2.91
(*SD*)		(3.03)		(4.28)		(3.72)		(3.12)		(4.50)		(3.87)
[0-3]	3 561	76.4%	2 658	65.2%	6 219	71.2%	3 326	71.6%	2 499	61.7%	5 825	67.0%
(3-7]	692	14.9%	799	19.6%	1 491	17.1%	781	16.8%	782	19.3%	1 563	18.0%
(7-14]	370	7.9%	512	12.6%	882	10.1%	495	10.6%	634	15.7%	1129	13.0%
>14	36	0.8%	106	2.6%	142	1.6%	46	1.0%	134	3.3%	180	2.1%
Body mass index	4 756	26.46	4 122	27.32	8 878	26.86	4 741	27.03	4 112	27.68	8 853	27.33
(*SD*)		(4.56)		(3.63)		(4.17)		(4.79)		(3.89)		(4.41)
<18.5	34	0.7%	5	0.1%	39	0.4%	51	1.1%	5	0.1%	56	0.6%
18.5-24.9	1 978	41.6%	1 122	27.2%	3 100	34.9%	1 714	36.2%	1 028	25.0%	2 742	31.0%
25-29.9	1 838	38.7%	2 151	52.2%	3 989	44.9%	1 874	39.5%	2 108	51.3%	3 982	45.0%
>30	905	19.0%	844	20.5%	1 749	19.7%	1 102	23.2%	971	23.6%	2 073	23.4%
Current smoker	890	18.9%	681	16.6%	1 571	17.9%	597	12.7%	459	11.3%	1 056	12.0%
Live with a spouse/partner	3 398	73.7%	3 440	84.6%	6 838	78.8%	3 030	69.1%	3 300	82.9%	6 330	75.6%
Self-rated health VAS (0-100)							4 634	75.48	4 038	76.52	8 672	75.96
(*SD*)								(17.12)		(15.86)		(16.55)
Subjective wellbeing (0-100)							4 374	72.20	3 885	73.17	8 259	72.66
(*SD*)								(21.34)		(19.73)		(20.60)

Note. *n* = number of subjects; *M* = mean; *SD* = standard deviation.

Supplementary Table 2: Descriptive overview of the educational differences in smoking, BMI, self-reported health and subjective wellbeing (SWB), separate for men and women in T7

	Women									Men								
	Primary/ secondary		Vocational/ high school		University degree, <4 yrs		University degree, ≥4 yrs			Primary/ secondary		Vocational/ high school		University degree, <4 yrs		University degree, ≥4 yrs		
	n	*M(SD)*/%	*n*	*M(SD)*/%	*n*	*M(SD)*/%	*n*	*M(SD)*/%	*p*	*n*	*M(SD)*/%	*n*	*M(SD)*/%	*n*	*M(SD)*/%	*n*	*M(SD)*/%	*p*
% Smokers	528	21.06%	522	19.32%	231	12.25%	257	7.25%	< .001 [b]	441	20.83%	466	15.75%	212	10.27%	155	6.13%	< .001 [b]
BMI	2 522	27.64 (5.17)	2 709	27.39 (5.09)	1 890	26.77 (4.80)	3 549	26.03 (4.62)	< .001 [a]	2 124	28.18 (4.24)	2 968	28.24 (4.10)	2 069	27.96 (3.90)	2 537	26.97 (3.60)	< .001 [a]
Self-rated health	2 426	71.35 (18.65)	2 676	74.83 (17.09)	1 871	77.21 (16.22)	3 530	79.50 (14.83)	< .001 [a]	2 062	73.49 (16.80)	2 925	75.75 (5.56)	2 052	76.65 (15.10)	2 519	79.31 (13.84)	< .001 [a]
SWB	2 206	71.55 (22.67)	2 590	69.79 (21.75)	1 841	69.33 (21.19)	3 485	72.61 (19.96)	< .001 [a]	1 945	70.78 (21.98)	2 861	71.53 (20.10)	2 029	70.69 (19.50)	2 487	72.33 (18.95)	.020 [a]

Note. *n* = number of participants; *M* = mean; *SD* = standard deviation; [a] Tested by one-way ANOVA; [b] Tested by Chi-square test.

Supplementary Table 3: Clustering of alcohol, BMI and smoking and years of education, self-rated health and subjective wellbeing (SWB), women in T7.

	Alcohol 0-7 units/week								**Alcohol >7-14 units/week**								**Alcohol >14 units/week**								
	BMI 18.5-25				BMI >25				BMI 18.5-25				BMI >25				BMI 18.5-25				BMI >25				
	Not current smoker		Current smoker		Not current smoker		Current smoker		Not current smoker		Current smoker		Not current smoker		Current smoker		Not current smoker		Current smoker		Not current smoker		Current smoker		
	n = 3 119		n = 567		n = 5 056		n = 763		n = 432		n = 72		n = 454		n = 87		n = 32		n = 17		n = 41		n = 14		
	M/%	(*SD*)	*M*/%	(*SD*)	*M*/%	(*SD*)	M/%	*SD*	*M*/%	(*SD*)	*M*/%	(*SD*)	*M*/%	(*SD*)	M/%	*SD*	*M*/%	(*SD*)	*M*/%	(*SD*)	*M*/%	(*SD*)	M/%	*SD*	*p*
University education	63.2 %		30.5 %		45.8 %		30.7 %		74.1 %		45.8 %		65.8 %		37.2 %		62.5 %		41.2 %		80.5 %		57.1 %		< .001[b]
Self-rated health	80.3	(15.6)	73.8	(17.5)	73.9	(17.2)	69.8	(18.1)	82.9	(12.7)	75.1	(14.8)	78.5	(13.0)	71.9	(7.8)	81.1	(13.5)	71.8	(17.1)	77.0	(17.6)	66.4	(13.1)	< .001[a]
SWB	73.1	(20.3)	65.1	(24.2)	70.9	(21.3)	66.1	(22.4)	75.8	(18.2)	68.78	(22.0)	73.0	(20.7)	67.8	(22.5)	74.8	(20.7)	51.0	(27.2)	77.1	(20.1)	62.7	(20.7)	< .001[a]

Note. *n* = number of participants; *M* = mean; *SD* = standard deviation; [a] Tested by one-way ANOVA; [b] Tested by Chi-square test.

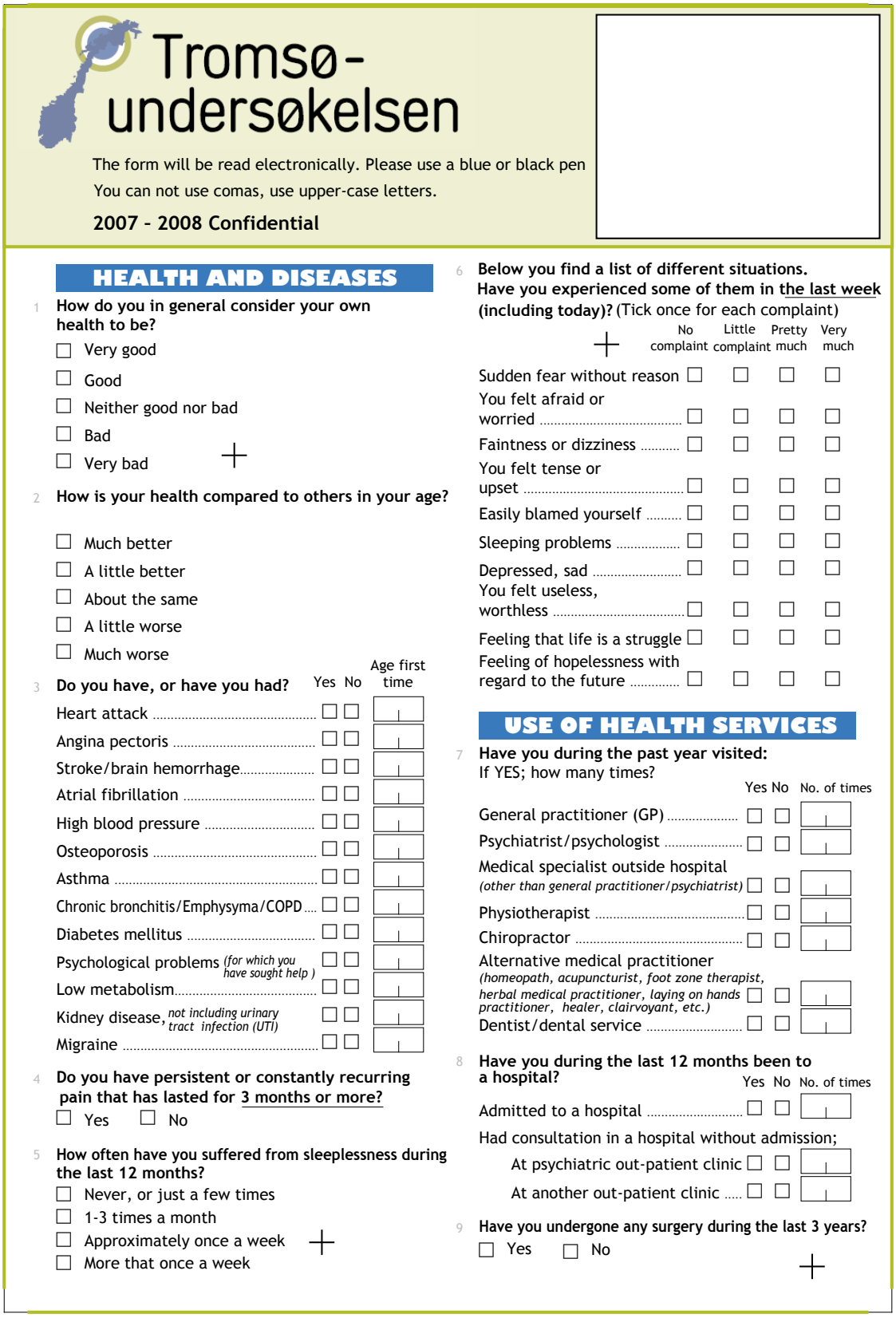
Supplementary Table 4: Clustering of alcohol, BMI and smoking and years of education, self-rated health and subjective wellbeing (SWB), men in T7.

	Alcohol 0-7 units/week								**Alcohol >7-14 units/week**								**Alcohol >14 units/week**								
	BMI 18.5-25				BMI >25				BMI 18.5-25				BMI >25				BMI 18.5-25				BMI >25				
	Not current smoker		Current smoker		Not current smoker		Current smoker		Not current smoker		Current smoker		Not current smoker		Current smoker		Not current smoker		Current smoker		Not current smoker		Current smoker		
	n = 1 591		n = 281		n = 5 300		n = 724		n = 334		n = 64		n = 1 008		n = 131		n = 44		n = 27		n = 203		n = 57		
	M/%	(*SD*)	*M*/%	(*SD*)	*M*/%	(*SD*)	M/%	*SD*	*M*/%	(*SD*)	*M*/%	(*SD*)	*M*/%	(*SD*)	M/%	*SD*	*M*/%	(*SD*)	*M*/%	(*SD*)	*M*/%	(*SD*)	M/%	*SD*	*p*
University education	54.8 %		26.5 %		44.3 %		25.7 %		70.5 %		33.3 %		61.2 %		40.8 %		77.3 %		37.0 %		63.6 %		43.9 %		< .001[b]
Self-rated health	79.6	(14.4)	74.7	(17.3)	76.1	(15.5)	72.2	(16.5)	79.9	(14.2)	72.1	(15.2)	77.9	(13.6)	71.3	(16.8)	77.9	(15.2)	72.4	(17.7)	73.9	(14.2)	68.6	(17.3)	< .001[a]
SWB	72.5	(18.8)	67.5	(23.1)	72.2	(19.8)	67.1	(22.1)	74.6	(17.5)	66.3	(21.4)	72.8	(19.1)	62.4	(20.0)	69.7	(22.0)	63.2	(26.5)	67.2	(22.1)	55.6	(25.6)	< .001[a]

Note. *n* = number of participants; *M* = mean; *SD* = standard deviation; [a] Tested by one-way ANOVA; [b] Tested by Chi-square test.

9 Appendices

Appendix 1: The Tromsø Study 2007-2008: Questionnaire 1



Tromsø-undersøkelsen

The form will be read electronically. Please use a blue or black pen
You can not use comas, use upper-case letters.

2007 - 2008 Confidential

HEALTH AND DISEASES

1 **How do you in general consider your own health to be?**

- ☐ Very good
- ☐ Good
- ☐ Neither good nor bad
- ☐ Bad
- ☐ Very bad

2 **How is your health compared to others in your age?**

- ☐ Much better
- ☐ A little better
- ☐ About the same
- ☐ A little worse
- ☐ Much worse

3 **Do you have, or have you had?**

	Yes	No	Age first time
Heart attack	☐	☐	
Angina pectoris	☐	☐	
Stroke/brain hemorrhage	☐	☐	
Atrial fibrillation	☐	☐	
High blood pressure	☐	☐	
Osteoporosis	☐	☐	
Asthma	☐	☐	
Chronic bronchitis/Emphysyma/COPD	☐	☐	
Diabetes mellitus	☐	☐	
Psychological problems *(for which you have sought help)*	☐	☐	
Low metabolism	☐	☐	
Kidney disease, *not including urinary tract infection (UTI)*	☐	☐	
Migraine	☐	☐	

4 **Do you have persistent or constantly recurring pain that has lasted for 3 months or more?**

☐ Yes ☐ No

5 **How often have you suffered from sleeplessness during the last 12 months?**

- ☐ Never, or just a few times
- ☐ 1-3 times a month
- ☐ Approximately once a week
- ☐ More that once a week

6 **Below you find a list of different situations. Have you experienced some of them in the last week (including today)?** (Tick once for each complaint)

	No complaint	Little complaint	Pretty much	Very much
Sudden fear without reason	☐	☐	☐	☐
You felt afraid or worried	☐	☐	☐	☐
Faintness or dizziness	☐	☐	☐	☐
You felt tense or upset	☐	☐	☐	☐
Easily blamed yourself	☐	☐	☐	☐
Sleeping problems	☐	☐	☐	☐
Depressed, sad	☐	☐	☐	☐
You felt useless, worthless	☐	☐	☐	☐
Feeling that life is a struggle	☐	☐	☐	☐
Feeling of hopelessness with regard to the future	☐	☐	☐	☐

USE OF HEALTH SERVICES

7 **Have you during the past year visited:** If YES; how many times?

	Yes	No	No. of times
General practitioner (GP)	☐	☐	
Psychiatrist/psychologist	☐	☐	
Medical specialist outside hospital *(other than general practitioner/psychiatrist)*	☐	☐	
Physiotherapist	☐	☐	
Chiropractor	☐	☐	
Alternative medical practitioner *(homeopath, acupuncturist, foot zone therapist, herbal medical practitioner, laying on hands practitioner, healer, clairvoyant, etc.)*	☐	☐	
Dentist/dental service	☐	☐	

8 **Have you during the last 12 months been to a hospital?**

	Yes	No	No. of times
Admitted to a hospital	☐	☐	
Had consultation in a hospital without admission;			
At psychiatric out-patient clinic	☐	☐	
At another out-patient clinic	☐	☐	

9 **Have you undergone any surgery during the last 3 years?**

☐ Yes ☐ No

USE OF MEDICINE

10 **Do you take, or have you taken some of the following medications?** (Tick once for each line)

	Never used	Now	Earlier	Age first time
Drugs for high blood pressure	☐	☐	☐	☐☐
Lipid lowering drugs	☐	☐	☐	☐☐
Drugs for heart disease	☐	☐	☐	☐☐
Diuretics	☐	☐	☐	☐☐
Medications for osteoporosis	☐	☐	☐	☐☐
Insulin	☐	☐	☐	☐☐
Tablets for diabetes	☐	☐	☐	☐☐
Drugs for metabolism Thyroxine/levaxin	☐	☐	☐	☐☐

11 **How often have you during the last 4 weeks used the following medications?**(Tick once for each line)

	Not used the last 4 weeks	Less than every week	Every week, but not daily	Daily
Painkillers on prescription	☐	☐	☐	☐
Painkillers non-prescription	☐	☐	☐	☐
Sleeping pills	☐	☐	☐	☐
Tranquillizers	☐	☐	☐	☐
Antidepressants	☐	☐	☐	☐

12 **State the names of all medications -both those on prescription and non-prescription drugs- you have used regularly during the last 4 weeks.** Do not include vitamins, minerals, herbs, natural remedies, other nutritional supplements, etc.

_____

_____

_____

_____

_____

_____

If the space is not enough for all medications, use an additional paper of your own.

When attending the survey centre you will be asked whether you have used antibiotics or painkillers the last 24 hours. If you have, you will be asked to provide the name of the drug, strength, dose and time of use.

FAMILY AND FRIENDS

13 **Who do you live with?** (Tick for each question and give the number)

	Yes	No	Number
Spouse/cohabitant	☐	☐	
Other persons older than 18 years	☐	☐	☐☐
Persons younger than 18 years	☐	☐	☐☐

14 **Tick for relatives who have or have had**

	Parents	Children	Siblings
Myocardial infarction	☐	☐	☐
Myocardial infarction before 60 years	☐	☐	☐
Angina pectoris	☐	☐	☐
Stroke/brain haemorrhage	☐	☐	☐
Osteoporosis	☐	☐	☐
Stomach/duodenal ulcer	☐	☐	☐
Asthma	☐	☐	☐
Diabetes mellitus	☐	☐	☐
Dementia	☐	☐	☐
Psychological problems	☐	☐	☐
Drugs/substance abuse	☐	☐	☐

15 **Do you have enough friends who can give you help when you need it?**

☐ Yes ☐ No

16 **Do you have enough friends whom you can talk confidentially with?**

☐ Yes ☐ No

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

☐ Never, or just a few times a year
☐ 1-2 times a month
☐ Approximately once a week
☐ More than once a week

WORK, SOCIAL SECURITY AND INCOME

18 **What is the highest level of education you have completed?** (Tick one)

☐ Primary, 1-2 years secondary school
☐ Vocational school
☐ High secondary school (A-level)
☐ College/university less than 4 years
☐ College/university 4 years or more

19 **What is your main occupation/activity?** (Tick one)

☐ Full time work ☐ Housekeeping
☐ Part time work ☐ Retired/benefit recipient
☐ Unemployed ☐ Student/military service

20 **Do you receive any of the following benefits?**

- ☐ Old-age, early retirement or survivor pension
- ☐ Sickness benefit (are in a sick leave)
- ☐ Rehabilitation benefit
- ☐ Full disability pension
- ☐ Partial disability pension
- ☐ Unemployment benefits
- ☐ Transition benefit for single parents
- ☐ Social welfare benefits

21 **What was the households total taxable income last year?** Include income from work, social benefits and similar

- ☐ Less than 125 000 NOK
- ☐ 125 000-200 000 NOK
- ☐ 201 000-300 000 NOK
- ☐ 301 000-400 000 NOK
- ☐ 401 000-550 000 NOK
- ☐ 551 000-700 000 NOK
- ☐ 701 000 -850 000 NOK
- ☐ More than 850 000 NOK

22 **Do you work outdoors at least 25% of the time, or in cold buildings (e.g. storehouse/industry buildings)?**

☐ Yes ☐ No

PHYSICAL ACTIVITY

23 **If you have paid or unpaid work, which statement describes your work best?**

- ☐ Mostly sedentary work *(e.g. office work, mounting)*
- ☐ Work that requires a lot of walking *(e.g. shop assistant, light industrial work, teaching)*
- ☐ Work that requires a lot of walking and lifting *(e.g. postman, nursing, construction)*
- ☐ Heavy manual labour

24 **Describe your exercise and physical exertion in leisure time. If you activity varies much, for example between summer and winter, then give an average. The question refers only to the last year.** (Tick the one that fits best)

- ☐ Reading, watching TV, or other sedentary activity.
- ☐ Walking, cycling, or other forms of exercise at least 4 hours a week *(here including walking or cycling to place of work, Sunday-walking, etc.)*
- ☐ Participation in recreational sports, heavy gardening, etc. *(note:duration of activity at least 4 hours a week)*
- ☐ Participation in hard training or sports competitions, regularly several times a week.

25 **How often do you exercise?** (With exercise we mean for example walking, skiing, swimming or training/sports)

- ☐ Never
- ☐ Less than once a week
- ☐ Once a week
- ☐ 2-3 times a week
- ☐ Approximately every day

26 **How hard do you exercise on average?**

- ☐ Easy- do not become short-winded or sweaty
- ☐ You become short-winded and sweaty
- ☐ Hard- you become exhausted

27 **For how long time do you exercise every time on average?**

- ☐ Less than 15 minutes
- ☐ 15-29 minutes
- ☐ 30-60 minutes
- ☐ More than 1 hour

ALCOHOL AND TOBACCO

28 **How often do you drink alcohol?**

- ☐ Never
- ☐ Monthly or more infrequently
- ☐ 2-4 times a month
- ☐ 2-3 times a week
- ☐ 4 or more times a week

29 **How many units of alcohol** (a beer, a glass of wine or a drink) **do you usually drink when you drink alcohol?**

- ☐ 1-2
- ☐ 3-4
- ☐ 5-6
- ☐ 7-9
- ☐ 10 or more

30 **How often do you drink 6 units of alcohol or more in one occasion?**

- ☐ Never
- ☐ Less frequently than monthly
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or almost daily

31 **Do you smoke sometimes, but not daily?**

☐ Yes ☐ No

32 **Do you/did you smoke daily?**

☐ Yes, now ☐ Yes, previously ☐ Never

33 **If you previously smoked daily, how long is it since you stopped?**

Number of years ☐☐

34 **If you currently smoke, or have smoked before: How many cigarettes do you or did you usually smoke per day?**

Number of cigarettes ☐☐

35 **How old were you when you began smoking daily?**

Number of years ☐☐

36 **How many years in all have you smoked daily?**

Number of years ☐☐

37 **Do you use or have you used snuff or chewing tobacco?**

- ☐ No, never
- ☐ Yes, previously
- ☐ Yes, sometimes
- ☐ Yes, daily

DIET

38 **Do you usually eat breakfast every day?**

☐ Yes ☐ No

39 **How many units of fruits or vegetables do you eat on average per day?** (units means for example a fruit, a cup of juice, potatoes, vegetables)

Number of units ☐☐

40 **How many times per week do you eat hot dinner?**

Number ☐☐

41 **How often do you usually eat these products?**
(Tick once for each line)

	0-1 times/ mth	2-3 times/ mth	1-3 times/ week	4-6 times/ week	1-2 times/ day
Potatoes	☐	☐	☐	☐	☐
Pasta/rice	☐	☐	☐	☐	☐
Meat *(not processed)*	☐	☐	☐	☐	☐
Processed meat *(sausages/meatloaf/meatballs)*	☐	☐	☐	☐	☐
Fruits, vegetables, berries	☐	☐	☐	☐	☐
Lean fish	☐	☐	☐	☐	☐
Fat fish *(e.g. salmon, trout, mackerel, herring, halibut, redfish)*	☐	☐	☐	☐	☐

42 **How much do you normally drink the following?**
(Tick once for each line)

	Rarely/ never	1-6 glasses /week	1 glass /day	2-3 glasses /day	4 or more glasses /day
Milk, curdled milk, yoghurt	☐	☐	☐	☐	☐
Juice	☐	☐	☐	☐	☐
Soft drinks with sugar	☐	☐	☐	☐	☐

43 **How many cups of coffee and tea do you drink daily?** (Put 0 for the types you do not drink daily)

	Number of cups
Filtered coffee	☐☐
Boiled coffee (coarsely ground coffee for brewing)	☐☐
Other types of coffee	☐☐
Tea	☐☐

44 **How often do you usually eat cod liver and roe?**
(i.e. "mølje")

☐ Rarely/never ☐ 1-3 times/year ☐ 4-6 times/year
☐ 7-12 times/year ☐ More than 12 times/year

45 **Do you use the following supplements?**

	Daily	Sometimes	No
Cod liver oil or fish oil capsules	☐	☐	☐
Omega 3 capsules *(fish oil, seal oil)*	☐	☐	☐
Vitamins and/or mineral supplements	☐	☐	☐

QUESTONS FOR WOMEN

46 **Are you currently pregnant?**

☐ Yes ☐ No ☐ Uncertain

47 **How many children have you given birth to?**

Number ☐☐

48 **If you have given birth, fill in for each child: birth year, birth weight and months of breastfeeding** (Fill in the best you can)

Child	Birth year	Birth weight in grams	Months of breastfeeding
1	☐☐☐☐	☐☐☐☐	☐☐
2	☐☐☐☐	☐☐☐☐	☐☐
3	☐☐☐☐	☐☐☐☐	☐☐
4	☐☐☐☐	☐☐☐☐	☐☐
5	☐☐☐☐	☐☐☐☐	☐☐
6	☐☐☐☐	☐☐☐☐	☐☐

49 **During pregnancy, have you had high blood pressure?**

☐ Yes ☐ No

50 **If yes, which pregnancy?**

☐ The first ☐ Second or later

51 **During pregnancy, have you had proteinuria?**

☐ Yes ☐ No

52 **If yes, which pregnancy?**

☐ The first ☐ Second or later

53 **Were any of your children delivered prematurely (a month or more before the due date) because of preeclampsia?**

☐ Yes ☐ No

54 **If yes, which child?**

1st child ☐ 2nd child ☐ 3rd child ☐ 4th child ☐ 5th child ☐ 6th child ☐

55 **How old were you when you started menstruating?**

Age ☐☐

56 **Do you currently use any prescribed drug influencing the menstruation?**

Oral contraceptives, hormonal IUD or similar ☐ Yes ☐ No

Hormone treatment for menopausal problems ☐ Yes ☐ No

When attending the survey centre you will get a questionnaire about menstruation and possible use of hormones. Write down on a paper the names of all the hormones you have used and bring the paper with you. You will also be asked whether your menstruation have ceased and possibly when and why.

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 <u>sittende</u> 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.

Appendix 3: Procedure for computing alcohol in units per week from frequency and units (Norwegian)

A - Hvor ofte drikker du alkohol?	***Values***
☐ Aldri	0
☐ Månedlig eller sjeldnere	0,25
☐ 2-4 ganger hver måned	0,75
☐ 2-3 ganger pr. uke	2,5
☐ 4 eller flere ganger pr.uke	5,5

B - Hvor mange enheter alkohol (en øl, et glass vin, eller en drink) **tar du vanligvis når du drikker?**	***Values***
☐ 1-2	1,5
☐ 3-4	3,5
☐ 5-6	5,5
☐ 7-9	8
☐ 10 eller flere	12

*New variable (A*B)* Alcohol units/week

Appendix 4: Bar graph illustrating the distribution of weekly alcohol units by 10-year age groups in T6 and T7