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An analysis of consumer characteristics, consumer attitudes, and consumption of vegetables, fruits and berries

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Abstract

This study investigated the relationship between characteristics, attitudes and lifestyle choices and consumption of vegetables, fruits and berries to identify possible factors that could be used for designing effective policy interventions. Data from Norwegian Monitor survey was used for estimating logistic regression models for vegetables and fruits/berries consumption. As potential determinants of consumption of vegetables, fruits and berries (F&V), price, income, gender, age, regions, households size, marital status, presence of children, educational level, physical activity, smoker, health consciousness, interest for magazines about health and diet, convenience, taste and quality are examined.

The marginal effects at mean analysis revealed that factors such as female, bachelor or master degree, health consciousness, interest for reading magazines about health and diet increase probability for consuming vegetables at least twice per day. Factors households with 5 members, convenience, taste, and Eastern, Western, Middle or Northern part of Norway as place of residence decrease the probability of consuming vegetables at least twice per day. For fruits/berries, the marginal effects at mean analysis revealed that factors such as female, physical activity, health consciousness and interest for reading magazines about health and diet increase probability of consuming fruits/berries at least twice per day. Factors such as price, smoker, convenience, taste, and Eastern, Western, Middle or Northern part of Norway as place of residence decrease the probability of consuming fruits/berries at least twice per day.

These results suggest that policy instruments such as taxes, subsidies and health information could be effective in increasing consumption of F&V.

Innholdsfortegnelse

1. Introduction

1.1 Background

An unhealthy diet is seen as one of the leading risk factors for sickness and premature deaths in both developing and developed countries (Helsedirektoratet 2016). World Health Organization (World Health Organization 2017) estimated that 5.2 million deaths worldwide were attributable to inadequate fruit and vegetable (F&V) consumption in 2013. In the western part of the world where most people have enough food, the challenges are to establish a healthy diet low on sugar and fat (Nasjonalt Råd for Ernæring 2011, WHO 1990). The awareness of a healthy diet's preventive potential for developing noncommunicable diseases, has been well documented the past years (Astrup 2001, Hu et al. 2014, Key et al. 2004, Nasjonalt Råd for Ernæring 2011, World Health Organizations/American Institute for Cancer Research 2007, WHO 1999, WHO 2003). The costs associated with poor health does not only impose cost on the society in form of deaths, but also in monetary form in terms of, for example, sick pay and loss of work hours (Furuberg & Thune 2015).

Increased occurrence of different diseases related to diet has become an increasing problem in Norway, as well as the rest of the world (Nasjonalt Råd for Ernæring 2011). Based on knowledge about the positive health effects of consuming vegetables, fruits and berries, and the current relatively low consumption levels of these produce among the Norwegian population, there are clear benefits of increasing the consumption. Rapid changes in diets and lifestyles have taken place with economic development and market globalization (WHO 1999). Standards of living has improved and food availability has expanded and become much more diverse as dietary pattern has become much more energy-dense. Fast food and snacks have become much more accessible and is usually more expensive than healthier choices. Also, cooking with F&V are by many seen as time-consuming and many do not like the taste (Opplysningskontoret for frukt og grønt 2016). These factors in combination with a sedentary lifestyle have significant impacts on health and nutritional status (WHO 1999).

WHO (2017) promote fruit and vegetable consumption around the world by recommending a minimum of 400 grams of fruits and vegetables per day, while the World Cancer Research Fund (2007) recommend a population average daily intake of at least 600 grams of fruits and vegetables for preventing cancer. In Norway, the Department of Health is responsibility for monitoring and evaluating the development and trends in the population's diet and to provide advice to promote public health. Efforts to increase F&V consumption have become an important element in the nutritional policy (Helsedirektoratet 2016). In 2012, Norway committed to follow the World Health Organization's (WHO) global goal to reduce premature deaths caused by noncommunicable diseases with 25 percent within 2025 (Helsedirektoratet 2016). The Department of Health recommends an intake of at least 500 grams of F&V per day, with roughly half of vegetables and half of fruit and berries. This corresponds to approximately 5 servings per day (Nasjonalt Råd for Ernæring).

A huge part of the the population does not follow these recommendations. According numbers from Norkost 3 (Totland et al. 2012), the total average F&V consumption was 363 grams for men and 387 grams for women in 2011. Only 24% percent men and 41% women consumed the recommended level of fruits, while the numbers of people consuming the recommended level of vegetables was even lower, respectively 15% women and 13% for men.

Numbers from Opplysningskontoret for frukt og grønt (2016), shows that sales volume of F&V per capita has remained rather stable since 2008. Vegetables have had a positive development in volume per capita with an average annual increase of 2.8%. For the period 2007 to 2016, it has been a per capita volume increase of 15.5% per capita. Sales volumes of fruits per capita has had a relative weak development during this periods, with a 7.9% decrease in per capita sales volume.

The purpose of the recommendations is to implement effective and sustainable policies and strategies to guide people towards a healthier lifestyle. However, there are still major nutritional challenges and potential health benefits to be gained. Because we are falling short of the recommendations, continued efforts are needed to address this issue (Bugge 2015). Understanding determinants of consumer behavior is a key component of developing effective behavioral interventions. A better understanding of this will make it easier to design effective nutrition interventions, guide product development, market decisions programs and health promotion campaigns.

The urgency for promoting healthy diets to stop the increasing rates of noncommunicable diseases has been recognized by policy makers in many countries and several instruments are being used to promote healthier diets (WHO 2015). Some of the instruments used are advertising, school lunches, information and labeling. WHO (2015) believe price policies, such as taxes and subsides that address affordability and purchasing incentives are key policy instruments for encouraging a healthy diet. Rickertsen (1995) found no significant effect of advertising on demand vegetables consumption, but did find estimated own-price elasticities demand for vegetables to be negative. Gustaven & Rickertsen (2006) showed that removing the value added tax (VAT) on vegetables increased consumption level only for those who already consumed a lot of vegetables.

1.2 Research question

In view of the large evidence on the potential health benefits from a high consumption of vegetables and fruits, it is beneficial to increase the per capita level of consumption. The main empirical objective of this study is to investigate the potential drivers of fruit and vegetable consumption. Identification of such factors can help the authorities to form effective measures to increase consumption levels. This will be investigated by preforming a logistic regression with data from Norwegian Monitor 2015

With this background, I have the following research objectives:

1. What is the relationship between consumer characteristics, consumer attitudes and consumption of vegetables, fruits and berries?
2. Can policy instruments such as subsidies, taxes, advertisement and health information contribute to increase consumption of vegetables, fruits and berries?

To get an indication of which determinants that influences consumption levels of vegetables, fruits and berries, this thesis will focus on estimating the effects of variables that previously have been found to be important in Norway and the rest of the world. The investigation centers on the characteristics of those who have high or low consumption levels of fruits and vegetables to better understand the consumption behavior. These differences can potentially be used to formulate more effective nutritional policies targeting low-consuming individuals.

2. Literature review

2.1 Convincing health effect

It has over longer period of time been a positive development in Norwegians diet (Helsedirektoratet 2016). Consumption of vegetables and fruit have increased and consumption of sugar decreased. Still, the Norwegian population are far from consuming the recommended levels of fruits and vegetables and there are major health benefits to gain.

During the past decades, research has led to persuasive scientific evidence concerning the protective effect of F&V consumption against noncommunicable diseases such as type 2 diabetes, cardiovascular disease, obesity and various cancers. In 2011, Nasjonalt Råd for Ernæring summarized the scientific findings the on relationship between F&V consumption and health. The conclusion was that there is a convincing correlation between intake and several chronic diseases (Nasjonalt Råd for Ernæring 2011). This gave the baseline for the Norwegian dietary advice recommending an intake of at least 5 servings of fruits, berries and vegetables per day. One serving is equivalent to 100 grams. Fruits and vegetables are an important part of a healthy diet because they contain high levels of dietary fiber, vitamins, iron and trace elements (Wandel, 1995).

The World Cancer Research Fund (WCRF) in England have done one of the largest studies on the relationship between diet and developing cancer. They reported in 2007 convincing evidence on the importance of a high consumption level of vegetables and fruit, and had an important part in developing the Norwegian dietary advices in 2011 (World Cancer Research Fund/American Institute for Cancer Research 2007). Since then, they have published several reports on the importance of a healthy diet. In 2011 they released a report with convincing evidence of dietary fiber and its effects on reducing the risk of colorectal cancer (World Cancer Research Fund/American Institute for Cancer Research 2011). According to WCRF, respectively 3.600 and 16.700 deaths caused by, mouth and throat, and lung cancer could be prevented in the UK each year if consumption levels of F&V were according to the recommendations (Public Health England 2016).

Finding the factors behind low consumption level of F&V is difficult because consumption behavior can be affected by different factors and often varies from person to person (Shepherd 1999). In the next section, previous research on the topic will be reviewed to create a baseline for the following analysis. A large and growing literature has examined the determinants of F&V consumption. There are numerous drivers of fruit and vegetable consumption and the scientific effort to identify determinants of F&V consumption has increased substantially. Some factors are more consistently supported by research than others. The aim for this section is to give a theoretical background that provides guidance and justification for how the analysis is conducted. Both results from dietary surveys and results from research using economic theory will be examined.

2.2 Determinants of consumption

Norwegian diet has showed positive development over time, with increased consumption of F&V over time and decreased consumption of sugar (Bugge 2010, Bugge 2015, Helsedirektoratet 2016, Opplysningskontoret for Frukt og Grønt 2015, Totland et al. 2012). However, the last couple of years this development has slowed down and there was no noteworthy increase in per capita consumption of F&V from 2014 to 2015 (Helsedirektoratet 2016).

A prerequisite for promoting a healthy diet as a foundation for preventive health care, is to have knowledge about which determinants that affect food choice in a population (Brug et al. 2008). Dietary choice is complex and involves much more than just the need for satisfying hunger (Shepherd 1999). There is no universal answer to what triggers food choice. To get knowledge of what characterizes high and low consumers of F&V, it is necessary to study these two groups. A lot of research has been done on this topic and the results are mixed. Demographic factors such as gender, age, income, education all play an important part in determining what kind of food is consumed (Thompson et al. 1999). Also psychological factors, individual preferences and lifestyle behavior influence choice of food. Some studies have focused on the socio-economic inequalities between individuals as the main reason for the differences in F&V consumption levels (Azagba & Sharaf 2011, Ball et al. 2005, Prättälä et al. 2009, Moreira & Padrão 2004). Others emphasize the economic and environmental factors as the key determinates (Conner & Garnett 2016). While some believe the differences is due to differences at the individual level (Shaikh et al. 2008), such as differences in attitudes towards healthy eating and knowledge about what is healthy food.

2.2.1 Economic variables

Price

Theory of demand is based on the relationship between consumer demand for goods and services and their prices (McElroy & Horney 1981). According to this theory, demand for a good decrease if the price increase. Wandel (1995) conducted a study of the Norwegian population aiming at discovering the factors influencing consumption of fruits, vegetables and potatoes, using logistic regression. Her study found that the factor that limits the consumption of fruits the most was preference for other foods, the second most limiting was price. For vegetables she found that the most limiting factor for low consumption was that it does not fit the meal pattern, while the second most limiting was price. This coincide with the findings in *Totaloversikten 2010-2015* (Opplysningskontoret for frukt og grønt 2015). Their findings states that the biggest barrier for consuming vegetables is bad quality and high price. The same was affirmed by Conner & Garnett (2016) which found price had a decreasing effect. This was not supported by the HealthMeal-project conducted in Norway 2010-2014, which concluded that individual preferences, and not structural factors like price, quality and assortment affected consumption of vegetables, fruits and berries (Bugge 2015).

Studies using economic models often find that price has negative impact on consumption. Rickertsen et al. (1995) found that uncompensated own-price elasticities for several different vegetables where statistically significant and ranging from -0.85 to -0.30 for different vegetable. Using aggregate market data Rickertsen (1998) found own-price elasticities ranging from -0.60 to -0.74. Gustavsen & Rickertsen (2006) analyzed demand for vegetables for high- and low consuming households using quantile regressions. Their results indicated that the risk of inadequate dietary diet and adverse health effects are larger in low consumption households. Their results show that own-price elasticity is only significate for high consuming households ranging from -0.36 to -0.42. A study of demand in the U.S found similar results with own-price elasticities ranging from -0.58 to -1.10 for different types of fruits and vegetables (Okrent & Alston (2012).

Income

According to the theory of demand theory, a rise income will lead to an increase in demand, hold everything else constant (McElroy & Horney 1981). Fruits and vegetables are expensive in Norway, and it is not an unfamiliar fact that higher income makes it easier to afford a healthy lifestyle (Blaylock et al. 1996). Wandel (1995) found that people with high income was less likely to consume vegetables seldom, and that this association was statistically significant. But there were no indication of high income increasing the probability of consuming and fruits or vegetables often either. Rickertsen (1994) estimated an income elasticity for vegetables of 0.5, whereas expenditure elasticities estimated for different vegetables by Rickertsen (1995) ranged from 0.68 or 1.10. Rickertsen (1998) found total expenditure elasticity for fresh vegetables in Norway to be 0.36. Øvrum, Gustavsen & Rickertsen (2013) investigated the relationship between age and socioeconomic inequalities using logistic regression models. Their findings indicate that higher income is positively related to the probability of consuming F&V, and that the there are strong differences in between income levels during late midlife, which decreases during late midlife. Whereas Øvrum & Rickertsen (2015) results indicated that income is unimportant in explaining overall inequality in consumption of fruit and vegetables. Also, Okrent & Altson (2012) found elasticites of demand for F&V with respect to total expenditure ranging from 0.03 and 0.06, but are not statistically significant.

2.2.2 Demographic and socioeconomic variables

Gender

Differences between gender and the consumption of F&V have been found in numerous studies all over the world. Men usually have a lower consumption level than women. Johansson & Andersen (1998) analyzed a nationwide survey on dietary habits in Norway, where they found that men reported lower frequency consumption of F&V than women. The median frequency among men was 2.9 and 3.4 among women. The same relationship between gender and consumption levels was found by Wandel (1995). Totland et al. (2012) summarizes the results from *Norkost 3,* a nationwide dietary survey conducted among the Norwegian population in 2010-2011, and found no significant differences between genders and consumption of vegetables, while men had higher consumption of fruits and berries. In 2016, the latest numbers on dietary habits were presented in *Utvikling i Norsk kosthold 2016* (Helsedirektoratet 2016). This article reports an average consumption of vegetables among men and women at about 150 grams per day. Less than 20% consumed more than 250 grams of vegetables per day. There was no significant difference between men and women in consumption of vegetables, but for fruits and berries, men seemed to consume less than women. The average consumption was about 168 for men, and 189 grams for women Compared to 1998 this is a decrease of approximately one serving per day for both genders. Also, Øvrum, Gustavsen & Rickertsen (2013) found that the odds of consuming of higher frequencies of F&V were 2.73 higher for women than for men, using logistic regression analysis. Similar results were found by Øvrum & Rickertsen (2015) were it was found that women on average are 19 percent points more likely to consume F&V at least twice per day than men.

Also studies abroad have found differences between men and women in relation to consumption of F&V. The Norbagreen study examined food behavior in the Nordic and Baltic countries and found that more men than women consumed fruit less than once a week in Sweden and Finland (Similä et al. 2003). Looking at daily consumption in Denmark, Finland and Island, consumption of vegetables, fruit and berries was lower among men than women in all countries. Especially men in Finland had a much lower intake of vegetables than consumers in other countries. Also studies outside Europe finds the same relationship between gender and consumption levels (Azagba & Sharaf 2011, Baker and Wardle 2003, Ball et al. 2005, Conner & Garnett 2016, Thompson et al. 1999)

Age

Also the relevance of age on consumption of F&V has been found by several studies. Wandel (1995) and Johansson & Andersen (1998) found association between increasing age and higher consumption levels of vegetables and fruits using respectively logistic regression and Bonferroni correction. Øvrum, Gustavsen & Rickertsen (2013) found that lifestyle habits tend to become healthier as age increase, but that this relationship only last until around late midlife. In contrast, results from Øvrum, A & Rickertsen (2015), where probit estimation was used, indicate that predicted value of consuming F&V twice per day decrease slightly with age. In *Norkost 3*, consumption of fruits and berries was found to increase with age for both genders, while there was no statistically difference between ages in consumption of vegetables (Totland et al. 2012).

Thompson et al. (1999) aimed at mapping out the profile of low consumers of fruits and vegetable in England in terms of demographic and behavioral factors. Being at an age between 16-24 years old compared to 45-75 years was found as one of the most important determinants for being a low consumer. Azagba & Sharaf (2011) found in their study that F&V frequency was lower among middle aged in Canada. Øvrum (2010) estimated demand for F&V using latent class analysis and his results found that F&V intake would increase with 0.034 more per week with each additional year of age.

Regional differences

Regional differences in policy interventions may be required if individuals respond differently to changes in determinants between regions. For example, can rural areas have less access to fresh produce and poorer selection than urban areas. However, the findings on the regional differences between consumption frequencies are mixed. No significant differences between regions and consumption levels of vegetables, fruits and berries was found in Norway by either Wandel (1995), Johansson & Andersen (1998) or Totland et al. (2012). In UK, studies have showed that people living in rural areas such as Scotland and the North East of England generally consume less vegetables compared to those living in urban areas such as South West, the Midlands, Wales, London and the South East (Pollard & Cade 2002, Billson et al. 1999). In *Totaloversikten 2003-2012*, the report showed that individuals living in urban areas had higher consumption frequencies of vegetables than individuals living in less urban areas and that consumption frequency increase with level of urbanization. (Opplysningskontoret for frukt og grønt 2012). This relationship consists with previous findings in Norway (Johansson et al. 1999).

Household size, marital status and presence of children

Numerous studies emphasize that explanation for disparities in consumption levels tend to be that more F&V is consumed when eating in company with others (Azagba & Sharaf 2011). Wandel's (1995) study found that those living in larger households were more likely to consume fruits and vegetables "often" than those with living alone and with low income. In contrast, presence of children increased the probability of consuming fruits seldom. The same was found in a later study by Totland et al. (2012). Øvrum (2010) estimated that weekly consumption intake would increase with 0.388 for unhealthy individuals and 0.242 for unhealthy individuals with kids living in the household.

Azagba & Sharaf (2011) studied disparities in the frequency of fruit and vegetable consumption by using quantile regression. Their findings discovered significant association between does who are married or in a relationship and household composition and frequency of F&V. Married individuals and individuals with children have higher probability of consuming F&V than those who are single and those without children. These findings are consistent with several previous studies done in other countries, such as the UK (Billson et al. 1999) and USA (Conner & Garnett 2016), Australia (Ball et al. 2005)

Habits such as eating in front of the television has also shown to correlate with consumption levels of F&V. Thompson et al. (1999) results showed that those eating in front of the television were more likely to be low consumers of F&V. This might reflect a larger reliance on convenience food, or fast food and reduction in occurrence of eating together as a family.

Educational level

Previous literature has used several explanations to justify the disparities in fruit and vegetables consumption by socio-economic differences. There is evidence that those with low income, little education and manual occupations are less likely to consume high levels of F&V, than those with high income, higher education and non-manual occupations (Department of Health 1996). It is commonly known that people with higher education tend to be more conscious about their food choices and therefore tend to have a healthier diet than people with lower education. Also, people with non-manual occupations often have higher education.

Several European studies have shown that socio-economic determinants such as level of education, income and occupation are associated with consumption of vegetables (Bugge 2015, Hulshof et al. 2003, De-Irala-Estévez et al. 2000, Johansson & Andersen 1998, Mackenbach et al. 2008, Kamphuis et al. 2006, Shkolnikov et al. 2012, Totland et al. 2012, Wandel 1995, Øvrum, Gustavsen & Rickertsen 2014). In *Norkost 3*, it was found statistical difference between educational levels, for both genders, and consumption of fruits, vegetables and berries (Totland et al. 2012). The same pattern was found by Øvrum, Gustavsen &

Rickertsen (2014) analyzing data from 1997-2001 using logistic regression. Their estimations found indicates that probability of consuming F&V were significantly higher for those with university degree. Also Johansson et al. (1999) found positive and statistical significant association between length of education and consumption of F&V using multiple regression models. According Øvrum (2010) individuals with unhealthy diets and college degrees, are associated with 7.17 more F&V intakes per week than individuals with no formal education

Prättälä et al. (2009) found that people with higher education consume more vegetables than others, especially in the Nordic and Baltic countries. The same association was found in Canada (Azagba & Sharaf 2011), the US (Conner & Garnett 2016) and Australia (Ball et al. 2005). This relationship was not found in Mediterranean countries where higher consumption level of vegetables was high, independent of socio-economic status (Irala-Estévez, et al., 2000; Roos, et al., 2000).

2.2.3 Attitudes and lifestyle choices

Physical activity

It is a widely known perception that individuals who regularly exercise tend to adopt healthy habits. Both Johansson & Andersen (1998) and Wandler (1995) found that those who exercised regularly had a higher frequency of consumption than others. Also a study among American undergraduate college students found that those who exercised were more likely to consume more than 5 servings of fruits and vegetables per day (Lowry et al. 2000). Similarly, Pearson et al. (2009) found using logistic and consumption of F&V that the likelihood of consuming more than 5 portions of F&V per day where higher for individuals with a high physical activity level.

Smoking habits

When comparing smokers and non-smokers and consumption of F&V, there is evidence indicating that non-smokers consume more F&V than smokers (Totland et al. 2012, Bugge 2015). Azagba & Sharaf (2011) found negative and significant association between current smokers and consumption levels, compared to non-smokers. These findings are consistent with previous studies done in other countries, such as the UK (Billson et al. 1999) and the U.S (Conner & Garnett 2016, Thompson et al. 1999)

Health consciousness

Health conscious individuals are usually concerned about their health and tend to have a healthier lifestyle than individuals that are less health conscious. Both Johansson & Andersen (1998) and Totland et al. (2012) found significant association between concerns about a healthy diet and high consumption of vegetables, fruits and berries in their studies. In *Norkost 3* (Totland et al. 2012), the Norwegian population reported they were more concerned about consuming adequate levels of vegetables than they were before. When they were asked why they didn't consume more, most reported that they believed non-organic and imported vegetables was bad for their health and for the environment. Many also reported that they already consumed enough of these products (Bugge 2015). The determinants found to influence Norwegian population coincides with research from other industrialized countries. Correlation between higher consumption of vegetables and fruits and concerns about health is found in the USA (Conner & Garnett 2016), the UK (Baker & Wardle 2003) and Australia (Ball et al. 2005). Another barrier for consumption, stated in *Totaloversikten 2010-2015* was lack of knowledge (Totland et al. 2015). They found that those with knowledge about the benefits of consuming vegetables are more positive to consuming vegetables than others. Surveys in the recent years have shown an increased knowledge of the Department of

Health’s dietary advices among the Norwegian population (Helsedirektoratet 2016). The share of men who had knowledge about the dietary advice in 2013 was just above 30 percent. While the share of women who knew this in 2016 was almost 50 percent. For women the share of people with this knowledge increased from 50 to around 60 percent. Baker & Wardle (2003) emphasize that low consumption has to do with lacking knowledge about the benefits of consuming adequate levels of F&V and how much is recommended. Their results show positive and significant effect of knowledge on consumption of F&V were consistent with the idea that knowledge has an influence on consumption levels. Their results also indicate that men have poorer nutrition knowledge and consume less F&V than women. Also (Ball et al. 2005) found that women who consumed more F&V had higher nutritional knowledge and support for healthy eating from family and friends.

2.2.4 Other determinants

The factors that characterizes different individuals and their dietary pattern are difficult to isolate. Economic, demographic and socioeconomic factors allow us to describe a population in a general term. This is important, but does not give us any further insight into what distinguish low and high consumers. To be able to describe the complexity of food behavior, individual characteristics and attitudes have to be explored. It is these factors that can tell us more about why people choose not to consume F&V..

Convenience

According to Opplysningskontoret for frukt og grønt (2015) a barrier for consuming vegetables is that it is time consuming, and suggest that offer more pre-cut and packed vegetables could be a solution to this. Glanz et al. (1998) conducted a study among the American population to assess dietary patterns using general linear models analyses. Their study found that convenience had positive and significant effect on consumption of F&V. This consist with Nijemeijer et al. (2004), which found convenience to be a central factor in vegetable consumption when analyzing the Australian population using multiple linear regression. Their results indicate convenience increase total vegetable intake with 3.73 per week.

Taste

The HealthMeal-project found that even though awareness of the importance of a healthy diet has increased, consumption levels of F&V are below the recommended levels and that one of the main reasons is taste (Bugge 2015). To reach the nutrition policy goals, Bugge emphasize the importance of giving vegetables a positive reputation and eliminating beliefs of potential dangers with vegetable production. Especially imported vegetables, which Norway is dependent on. Also *Totaloversikten 2010-2015* (Opplysningskontoret for frukt og grønt 2015) states that taste is the most important driver for consuming vegetables. They also highlight the ongoing health trend for making vegetables a natural part of the modern diet. Baker & Wardle (2003) found significant association between taste and consumption of vegetables and fruits, and that liking F&V increased consumption with 0.08 per day. Similar results were found among the American population by Glanz et al. (1998) which found that taste was one of the most important factors for consuming F&V.

Quality

According to Opplysningskontoret for frukt og grønt (2015), is bad quality one of the main reason for not buying vegetables. Whereas numbers from the HealthMeal-project Bugge (2015), few people reported that bad quality was the reason for not consuming vegetables. This does not coincide with Furst et al. (1996) which found that quality was one of the main values for consuming vegetables. Also Lennernäs et al. (1997) found that quality was one of the most important factors influencing consumer food choice.

2.3 Policy instruments

There exist several approaches aiming at increasing consumption of F&V. Policy instruments such as subsidies, taxes, information, advertising, labeling and school lunches are some of these instruments. In order to have any effect, it is important that the instrument used target areas that is likely have influence on consumption levels. Rickertsen et al. (1995) investigated the effect of advertising on consumption of F&V using the almost ideal demand system (AID), but found no significant effect on vegetable demand. This system assume prices are predetermined, but due to application of strict import regulations, and the fact that many fresh vegetables are not fit for storage, an inverse demand system is more plausible for investigating the relationship between advertising and consumption of vegetables (Rickertsen 1998). However, the conclusion of no significant positive effect of advertising was supported by Rickertsen (1998) using the inverse AID.

The effect of adjusting Norwegian value-added tax (VAT) to promote healthier diets in Norway was investigated by Gustavsen & Rickertsen (2013). They used a censored quantile regression approach to investigate differences between low, median and high purchasing households of an increase in VAT rates on some unhealthy foods and removal of the VAT on some healthy foods. Their findings indicated that an increase in VAT is more effective in reducing purchases of unhealthy foods among high-purchasing households than the removal of VAT is on increasing purchase of healthy foods among low-purchasing households. They also found that subsidizing was not effective if not targeted directly at consumers who consume small quantitates of healthy foods. Also a censored quantile regression analysis conducted by Gustavsen & Rickersen (2006) found that removing VAT mainly increase vegetable demand in high-consuming households. Gustavsen & Rickrtsen (2006) found that total expenditure elasticity of vegetables decreases from 0.9 in low-consuming household to below 0.5 in high-consuming households, which indicates that income support could be a potential instrument for increasing consumption.

2.4 Norwegian Monitor Portal

Ipsos, which is the company behind the survey Norwegian Monitor, have created an analyzing program based on plug and play configurations called Norwegian Monitor Portal (Ipsos 2015). The program consists of several functions which provides the opportunity to conduct monitor-related analysis. "Valuemap" is a dimension analysis used to identify values that tend to affect the same people and those who rarely do, to describe the value pattern in the population. The population is placed on two main dimensions that appear to be the most important socio-cultural dividing lines: Dimension 1, ranging from change-oriented and modern values to stability-oriented and traditional values. Dimension 2, which explains the second most of the differences in value, goes from the materialistic values to the idealistic. From this the value the population is divided into 4 main groups (Figure 1 and 2): Modern materialist (top left), Modern idealist (top right), Traditional idealist (bottom right) and Traditional materialist (bottom left) in Figure 1 and 2. With this, among many other things, they can explore what kind of people fall into the different categories. To get an indication of what characterizes low and high consumers, data from Norwegian Monitor Survey 2015 was analyzed in this program. Those consuming vegetables twice per day is categorized as high consumers, and those consuming less than twice per day were categorized as low consumers. The same was done for fruits/berries. I also made a cut-point at three times per day, but it did not seem to be any distinct differences in characteristics between the individuals in the two groups. With the cut-point at two times per day, the high consumers fall into the materialistic idealist area, while low consumers fall into the middle, leaning towards the traditional materialist type. This is shown by the blue colored stars in the diagram. The quadratics near the blue colored stars are those "values" which are most associated with each of the two groups.

Figur 1: Value map for fruits/berries

Figur 2: Value map for vegetables

To further consider which values typically matters to individuals in each of the two groups the function "Superdig" was used. A chi-squared test is used to determine if there is a significant difference between the chosen consumer group and a question from the survey. Values over 20 indicates a significant correlation between the variable and the chosen group. Those who responded that they consume vegetables more than twice a day were people 25-39 years old living in a big city with high education. They also care about the environment, health and equality. This relationship was not seen among high consumers of fruits/berries. Health and diet seems to be the most important factors for high consumers of fruits/berries.

However, besides from giving an interesting description of what is typical for consumers of F&V consumption in Norway, this analysis does not provide any useful information to form any policy instruments. Therefore, I will not pursue this any further.

2.5 Summarized findings from literature review

The results from previous literature is somewhat mixed. The most common findings in this literature review are:

- An increase in price of F&V decrease consumption of F&V
- Economic theory strongly suggests that consumption increase when income increase. This is also find in most of the studies mention in the literature review.
- Women consume more vegetables, fruits and berries than men.
- Consumption levels of F&V tend to increase with age.
- Studies in Norway do not find noteworthy differences in consumption levels between regions in Norway.
- There is evidence indicating that eating together with other people and presence of children has positive impact on consumption of F&V.
- Individuals with higher level of education and income are more likely have higher consumption level of F&V than those who have not completed higher education.
- Individuals who are health conscious, have more knowledge about the benefits of a healthy lifestyle, physical activity and are non-smokers, are more likely to consume higher levels of F&V.
- Convenience and taste is a barrier for F&V consumption.
- The use of taxes as policy instrument seems to have better effect on reducing unhealthy food consumption than on increasing consumption of healthy food.

Hypothesis

Based on the findings from the literature review I would like to investigate the following factors and consumption of F&V:

The most important factors are:

- Gender
- Income
- Education
- Price
- Health consciousness
- Convenience
- Taste

Less important factors are:

- Quality
- Household size
- Physical activity
- Smoking habits
- Physical activity
- Marital status
- Presence of children

Not influencing F&V consumption:

- Age
- Region

I will not test for the effect of knowledge about health benefits of adequate consumption of F&V or advertising because the dataset did not include any variables for this factor. The variables will be divided into 4 groups; economic variables, demographic and socioeconomic variables, attitudes and lifestyle choices and other variables.

3. Data and description of variables

In this chapter I will present the data used for the this analyze and give a description of the variables included in the model. I will also describe the model which will be used for estimating the model. One regression for fruits/berries and one for vegetables will be estimated. This study uses explanatory variables that based on the findings in previous studies (see chapter 2). The objective is to estimate the effect of demographic characteristics, attitudes and behavior on consumption of vegetables and fruits/berries.

3.1 The Norwegian Monitor Survey

The data is obtained from the Norwegian Monitor Survey. Ipsos Norway is the company behind the survey and is a nationally representative survey for people over the age of 15. The survey aims at giving a broad and detailed description of the Norwegian society. The survey measures change in rating of socio-cultural values over time, describing the true socio-cultural trends that affect society's development and changes in people's adaptation in different arenas. The survey contains around 300 questions about attitudes, preferences and habits, in addition to drivers and barriers behind behavior. The survey has been conducted every second year since 1985 and is one of the largest in Norway. The data is collected by phone interviews in combination with a self-report interview. For this analysis only data from 2015 survey is used that includes 3.981 participants between the ages 15-96. Due to missing information for some of the explanatory variables they are deleted and a final sample of 3431 observations is used.

3.2 Outcome variable

The outcome variable for both models are measures of consumption frequencies. The variable is based on survey questions about how often the respondent consume vegetables or fruits/berries. The response alternatives to this question is as follows; “4 times per day”, “3 times per day”, “2 times per day”, “1 time per day”, “5-6 times per week”, “3-4 times per week”, “1-2 times per week”, “1 time per month” and “rarely/never”. The variable is coded 1 for those who consume vegetables or fruits/berries at least twice per day and 0 otherwise.

3.3 Explanatory variables

3.3.1 Economic variables

The original survey question pertaining household income included eleven response alternatives, representing a specific income interval. Based on this, a semi-continuous income measure was constructed by setting household income to the mid-point value of each income interval. The dataset did not contain prices, but it did have a question on how important prices are when buying food, which is used as a measure for price instead. Since only data from one year is used, and since prices stay fairly constant over a year, this is a reasonable measure for price. Price is coded 1 if price is stated as the most important factor when buying food, 0 otherwise.

3.3.2 Demographic and socioeconomic variables

Demographic and socioeconomic characteristics is assessed with the following variables gender, age, region, household size, marital status, presence of children and educational level. All variables, except age which is continuous, are coded as dichotomies. The gender variable is coded as 1 if the respondent is female, 0 otherwise. In order to capture regional differences, dummies are created for “Oslo and Akershus” (O&A), “Eastern Norway”, “Western Norway, Mid-Norway” and “Northern Norway”. Similarly, is household size categorized into four groups ranging from one to more than seven people living in a household, with one dummy is created for each number of household members. Marital status is coded 1 if married or living together with their partner, and 0 if divorced, never married or widow/widower. The variable for presence of children is coded 1 if any children are living at home, and 0 otherwise. Education is categorized into four groups, ranging from completing primary school to having obtained a master degree. One dummy is created for each educational group.

3.3.3 Attitudes and lifestyle choices

Questions about physical activity, health consciousness and smoking habits are used as measure for attitudes and behavior. Two variables are included as measure of health consciousness. The first question is a measure of how interested the respondent is in reading magazines about health and diet. This variable is coded 1 for the response “very interested” and 0 otherwise. The other is a measure of how important maintaining a healthy lifestyle and staying physical active is. This variable is coded 1 for response alternatives “totally agree”, and 0 otherwise. Physical activity is based an 8-point scale ranging from “never” to “once or more per day” and is coded 1 for those who report that they do physical activity at least twice per week, and 0 otherwise. Smoking status is categorized into daily smoker, coded as 1, and non-smoker, coded as 0.

3.3.4 Other variables

Taste is based on a question about whether taste or healthiness is most important when it comes to food. The 4-point scale response range from “totally disagree” to “fully agree”, in addition to the response alternative “impossible to answer”. The variable was coded 1 for response alternatives “totally agree”, and 0 otherwise. The variable convenience is based on a question about what is important when buying food and is coded 1 if the answer is “convenience”. Quality is assed with a question about what the respondent cares most about when it comes to food, quality or price. The variable is coded 1 if the response is “totally disagree”.

A detailed definition of the variables is presented in Table 1.

4. Methods

First, a regression with the economic variables will be estimated. Then demographic variables will be added to the model before the variables for attitudes and lifestyle choices will be included. Finally, other variables describing more personal attributes are added to the model. The models will be compared using a likelihoods ratio test and the model with best fit will be used for further analysis.

4.1 Random Utility Model

The following description of the random utility model is obtained from Train (2009 s. 14-17). A model with a discrete dependent variable is often derived under the assumption of utility-maximizing behavior by a decision maker. Models that can be derived from maximizing utility is called the random utility models (RUMs). A decision maker (n) that faces a number of possible alternatives (K) which all gives certain levels of utility. The utility a decision maker n obtains from alternative k can be written as U_{nk}, k=1,….K. The decision maker will choose the alternative with highest possible utility: alternative i is chosen over k if $U_{ni} > U_{nk}$ $\forall \ k \neq i$. The decision maker knows what level of utility he/she has for each alternative, but this is not observable for anybody else. What is observable is some attributes of the alternatives faced by the decision maker, x_{nk} $\forall k$, and some attributes of the decision maker, s_n. From this, a function can be specified that relates the observed factors to the decision maker´s utility. This function is called representative utility and is denoted $V_{nk} = V(x_{nk}, s_{\boldsymbol{n}})$ $\forall k$. It is not possible to observe the true utility. It is only possible to estimate $U_{nk} = V_{nk} + u_{nk}$, where u_{nk} is the error term representing the difference between the true utility and the estimated utility. The error term is treated as random and the joint density of the random vector $\mathbf{u}'_n = (u_{n1},\ldots u_{nK})$ is denoted $f(u_n)$. With this density function, probabilities concerning choice of alternatives can be estimated. The probability of choosing alternative i is:

$$P_{ni} = \text{Prob}\ (U_{ni} > U_{nk}\ \forall \ k \neq i)$$
$$= \text{Prob}\ (u_{nk} - u_{ni} < V_{ni} - V_{nk}\ \forall \ k \neq i\ ) \qquad (1)$$

This probability is a cumulative distribution, which means that $u_{nk} - u_{ni} < V_{ni} - V_{nk}$. Using the density function, this can be written as:

$$P_{ni} = \int_u I\ (u_{nk} - u_{ni} < V_{ni} - V_{nk}\ )\ f\ (u_n) du_n, \qquad (2)$$

where I is the indicator function, equaling 1 when the expression is true and 0 otherwise.

Which discrete choice model is expressed depends on how the density is defined. For logit, $f(u_n)$ have a closed form solution and is derived from the assumption that the unobserved part of the utility is independent and identically extreme distributed extreme value.

4.2 Logistic regression

To examine the characteristics typical for high consumers of vegetables and fruits/berries, two logistic regression models are estimated. The aim is to assess whether there exist statistically differences between individuals who consume high frequencies of vegetables and fruits/berries. Regression models are generally used to analysis the effect of an independent variable on an outcome variable. Contrary to a standard linear regression, a logistic regression can be used when the outcome variable is binary.

A logistic logistic regression model predicts the probability of an outcome based on a set of explanatory variables. In this analysis it will be used to predict the probability of an individual consuming vegetables or fruits/berries at least twice per day. Respondents are categorized into two groups, coded as 1 for those consuming twice or more per day, and 0 for those who consume less than this. This makes the depend variable binary and is the reason for choosing a logit model.

In linear regression models (LRM), the coefficients can be interpreted as they are reported (Long & Freese 2014). For nonlinear models, such as logit, additional calculations have to be preformed after the estimates are obtained (Long & Freese 2014). Because the outcome is nonlinear the coefficients cannot be effectively interpreted by just looking at the estimated parameters. (Long & Freese 2014). Marginal effects at the mean will be estimated for interpretation. This is more informative than odds ratios in terms of magnitude effects. In a logit model, a marginal effect measures the change in the probability of the outcome, in this case consumption of vegetables or fruits/berries, by a change in an explanatory variable, holding all other variables constant at specific values (Long & Freese 2014).

4.2.1 Deriving the logit from RUM

The following description of how to derive the logit model from the random utility model is obtained from Train (2009 s. 34-41). The logit model can be derived from the random utility model (described in chapter 4.1) by assuming that u_{nk} and u_{nk} are iid extreme value. The density for each unobserved component of utility is:

$$f(u_{nk}) = e^{-u_{nk}} e^{-e^{-u_{nk}}} \tag{3}$$

and the cumulative distribution is:

$$F(u_{nk}) = e^{-e^{-u_{nk}}} \tag{4}$$

By assuming the variance of this distribution is $\frac{\pi^2}{6}$, the scale of utility is implicitly normalized. The difference between two extreme value variables, $ü_{nk} = u_{nk} - u_{ni}$, has the logistic distribution:

$$F(ü_{nki}) = \frac{e^{ü_{nki}}}{1+ e^{ü_{nki}}} \tag{5}$$

If the error terms are iid extreme value, we can derive the logit choice probabilities. The choice probability is the integral of the individual cumulative distributions over all values of u_{ni} weighted by its density (4).

$$P_{ni} = \int \left(\prod_{k \neq i} e^{-e^{-(\ddot{u}_{ni} + V_{ni} - V_{nk})}} \right) e^{-u_{ni}} e^{-e^{-u_{ni}}} d\, u_{ni} \qquad (6)$$

Some algebraic manipulation and the logit choice probability is obtained:

$$P_{ni} = \frac{e^{V_{ni}}}{\sum_k e^{V_{nk}}} \qquad (7)$$

Utility is typically represented by linear parameters such that V_{nk} = $\mathbf{x}_{nk}\boldsymbol{\beta}$, where $\mathbf{x}_{nk}$ is a vector for observed variables relating to alternative *k*. With this specification the logit model can be derived. The estimation of the logit model will be described in more detail in the next paragraphs.

4.2.2 Deriving the logit model

The following description of how to derive the logit model is obtained from Long & Freese (2014 ch. 5), Stock & Watson (2015 s. 437-446) and Wooldrigde (2014 s. 460-473).

A logit model is a nonlinear regression model used for binary dependent variables. A logistic regression models the probability, *P*, of *y* =1 given a set of explanatory variables:

$$P\,(y\ =\ 1 \mid \mathbf{X})\ =\ P\,(y\ =\ 1 \mid x1, x2, x3, \dots, xk) \qquad (8)$$

Where y =1 represents consumption of vegetables or fruits/berries at least twice per day. **x** represents the full set of explanatory variables. A binary regression model can be used to examine the effect of each explanatory variable on the probability of an event, in this case the probability of being a high consumer of vegetables or fruits/berries. Because the dependent variable only can take on the values 0 and 1, the logistic regression is represented by a cumulative distribution function (cdf) F:

$$P\,(y\;=\;1\,|\,\mathbf{X})\;=\;F(\mathbf{x\beta}) \qquad (9)$$

β represents the full set of betas. This function, F, makes sure that the probabilities are between zero and one: $0 \leq P \leq 1$.

In the logit model, F is given by the logistic function:

$$F\,(\mathbf{\beta x})\;=\;(\frac{e^{\,x\text{ß}}}{1+e^{x\text{ß}}}) \qquad (10)$$

Which is between zero and one for all real numbers. This function is the odds of y = 1, given a set of explanatory variables.

A logit model can be derived from an underlying latent variable model:

$$y_n^* = \; x_n\mathbf{\beta} + u_n$$

where y* is an unobserved variable, ranging from - ∞ to ∞, related to the observed independent variables by this structural model. u is a random error with standard logistic distribution and n denote the observation. The latent variable in this analysis is an underlying propensity to consume more than two vegetables or fruits/berries per day. The observed binary dependent variable is coded 1 for a positive outcome, and 0 for a negative outcome. A measurement equation defines the link between the binary observed variable y_n and the continuous latent variable y_n*:

$$y_n = \begin{cases} 1 \; if \; y^* & > 0 \\ 0 \; if \; y^* & \leq 0 \end{cases}$$

Logit regression functions are nonlinear functions of the coefficients. The logit coefficients appear inside the cumulative standard logistic distribution function *F*. Because the regression function is a nonlinear function of the coefficients, they cannot be estimated by ordinary least square (OLS) like linear regression models. Logit models are fit using maximum likelihood (ML). The ML estimator maximize the log-likelihood function

$$ln\, L = \prod_{n=1}^{N} [y_{ni} \ln F(\boldsymbol{\beta}\mathbf{x}_{ni}) + (1 - y_{ni}) \ln(1 - F(\boldsymbol{\beta}\mathbf{x}_{ni}))] \qquad (11)$$

for a sample of N independent observations. The maximum likelihood estimators are derived by the iterative methods and are asymptotically normally distributed, consistent and attains the smallest variance among all estimators (Cameron & Trivedi 2009).

4.2.3 Interpretation of the model

The estimated log-odds derived from the iterative methods have little substantive meaning when it comes to interpret magnitude effects from a change in a variable. Therefore, are the log odds added in the appendix, while odds ratios are calculated and used for examining the effects of the variables.

The odds ratio is the change in odds of an outcome by a change in an explanatory, while holding all other variables constant. It is a measure of association between the explanatory variable and the outcome (Morgan & Teachman 1988). For an odds ratio equal to one, the explanatory variable does not effect the odds of the outcome. For an odds ratio less than one, the explanatory variable is negatively associated with the odds of the outcome, while an odds ratio greater than one indicate positive association with the odds of the outcome. The odds ratio contains no information about the magnitude of the change in the probability of the outcome (Long & Freese 2014). Therefore, marginal effects at the mean will be estimated for the model with the best fit.

The marginal change at the mean measures the change in the probability of an outcome for a change in an explanatory variable, holding all other independent variables at their mean (Wooldrigde 2014). When holding all other variables at their means we obtain marginal effect for the average person in the sample. For continuous variables, the marginal effect measures the change in probability of the outcome from a one unit change in the explanatory variable on the outcome, holding all other variables constant. For dichotomous variables, the marginal effect measures the change in the probability of the outcome from change in the explanatory variables from 0 to 1, holding all other variables at their mean (Long & Freese 2014).

4.2.4 Measure of fit

Before estimating the model in STATA, all variables were tested for Multicollinearity (the result is added in appendix). None on the variables seems to be highly correlated. LR χ^2 is the value of a likelihood-ratio chi-squared for the test of the null hypothesis that all coefficients associated with the independent variable are simultaneously equal to zero (Cameron & Trivedi 2009). Significance level will be denoted with asterisks indicating level of significance. One, two and three asterisks respectively represent significance level at 1%, 5% and 10%. Only values under the 5% level will be interpreted as significant. The Pseudo R^2 is a measure of fit, but because the estimates from a logistic regression are estimated by maximum likelihood and calculated by an iterative process, they are not calculated to minimize variance as it is for OLS, and therefore not a god measure for comparing models. Instead, a likelihood-ratio test (LR-test) is used to compare all the estimated models. The LR-test tests the null hypothesis of the added variables being jointly equal to zero. The test compares the log likelihoods of the models and test whether there is a statistical significance of the restricted parameters. If the constraints significantly reduce the log likelihood, then the null hypothesis is rejected and indicates that the added variables are jointly statistically significant from zero (Long & Freese 2014). Variables will be added group wise and then compared with each other. First the economic variables will be added (1), then the demographic and socioeconomic (2), then the attitudes and lifestyle variables (3), and finally other variables (4).

5. Results

5.1 Descriptive statistics

Table 1 show the summary statistics with the mean and standard error and a description of the variables. The distribution by gender, age and region among the participants was relatively similar to the population at average. Approximately 53% of the respondents in the sample are women and the average age is 47.4. When it comes to price, only 9.5% of the sample reported that price is the most important factor when they buy food. Figure 3 show the distribution of the respondents answer to the question that is used for assessing the price variable: “What is the most important factor when buying food?”. The figure shows that most of the respondents answered that taste was most important factor, while the second most important was that the food is safe and does not contribute to sickness. Furthermore, average annual income is 431.565 NOK.

Approximately 26 % and 17% of the sample consumes fruits/berries and vegetables, respectively, at least twice per day. Figure 4, 5 and 6 depict variations in consumption frequencies between genders. Figure 4 show the proportion of respondents which responded that they consume vegetables or fruits/berries at least twice per day, and the distribution of men and women. It is a clearly larger portion of women consuming vegetables and fruits/berries at least twice per day. Figure 5 and 6 show the number of respondents which answered each response alternative for men and women. For all consumption frequencies “one time per day” or high, is the proportion of women is higher than men.

There are few respondents from Northern part of Norway (9%), but quite even distribution of respondents from the other regions. Distribution of respondents with household sizes 1-5 is 20.7%, 38.7%, 14.3% and 15%. 41.4%, while respondents living in households with than 5, 6 and more than 6 is quite underrepresented in this sample with respectively 8.2%, 1.6% and 0.8%. 62.5% are married, have cohabitant or is in a relationship, and 38.7% have children living at home. Roughly 34%, 32% and 24% have completed, respectively, secondary school, bachelor or master degree as highest level of education, while only 0.1% of the sample have completed primary school as highest level of education. Figure 7 and 8 illustrates the difference between educational level and consumption frequency of vegetables and fruits/berries. From Figure 7, it is clearly more people with bachelor and master degree that reported consumption frequencies of vegetables “one per day” or higher. Figure 8 show that consumption frequency for fruits/berries also appear to increase with educational level, but for fruits/berries this pattern is seen from consumption frequencies “twice per day” or higher.

When it comes attitudes and lifestyle choices, 41% does physical activity at least twice per week and only 10% of the respondent’s report that they smoke daily. 34% report that they are health conscious, but only 16% are very interested in reading magazines about health and diet. Approximately 17% and 32 % think that taste and convenience are important factors when buying food, while 24.5% report that quality is more important than price when it comes to groceries.

Table 1: Variable descriptions and summary statistics

Variable	Description	Mean	Std. Dev
Fruits/berries	Consume fruits/berries at least twice per day	0.262	0.440
Vegetables	Consume vegetables at least twice per day	0.174	0.379
Price	Price is the most important factor when buying food	0.095	0.294
Income	Household income	431.565	286.972
Female	Respondent is female	0.525	0.499
Age	Age of respondent	47.439	18.654
Region			
O&A	Lives in Oslo & Akershus	0.236	0.425
Eastern N	Lives in Eastern part of Norway besides O&A	0.286	0.452
Western N	Lives in Western part of Norway	0.242	0.429
Mid-N	Lives in Mid- Norway	0.146	0.353
Northern N	Lives in Northern part of Norway	0.090	0.286
Househ. Size			
1	One person living in the household	0.207	0.406
2	Two persons living in the household	0.387	0.487
3	Three persons living in the household	0.143	1.05
4	Four persons living in the household	0.153	1.44
5	Five persons living in the household	0.082	1.38
6	Six persons living in the household	0.016	0.754
7	More than six persons living in the household	0.084	0.641
Marital status	Married or cohabitant	0.625	0.484
Children	If children living at home	0.387	0.487
Education			
Primary	Primary school is highest completed level of education	0.099	0.298
Secondary	Secondary school is highest completed level of education	0.340	0.474
Bachelor	A bachelor degree is highest completed level of education	0.322	0.467
Master	A master degree highest completed level of education	0.238	0.426
Physc Act.	Do physical activity at least twice per week	0.413	0.492
Smoker	Smoke daily	0.104	0.305
Health con	"Totally agrees" to the statement: "I am always concerned about living healthy and keeping in good physical shape"	0.342	0.474
Magazine	"Very interested" in reading magazines about health and diet	0.159	0.366
Convenience	If "convenience" is an important factor when buying food	0.317	0.465
Taste	If taste is more important than how healthy the food is	0.169	0.375
Quality	If quality is more important than price when it comes to groceries	0.245	0.430

Norwegian Monitor Survey 2015. Summary statistics based on 3431 observations.

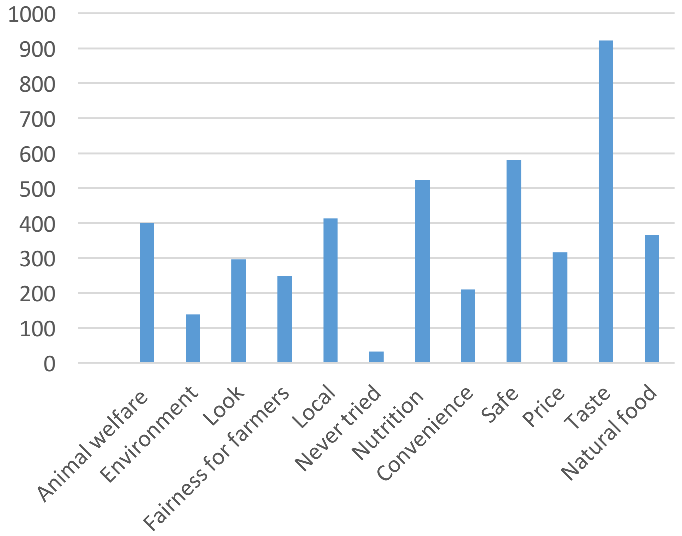

Figure 3: Most important factor when buying food

Figure 4: : Number of respondents that consume vegetables and fruits/berries at least twice per day

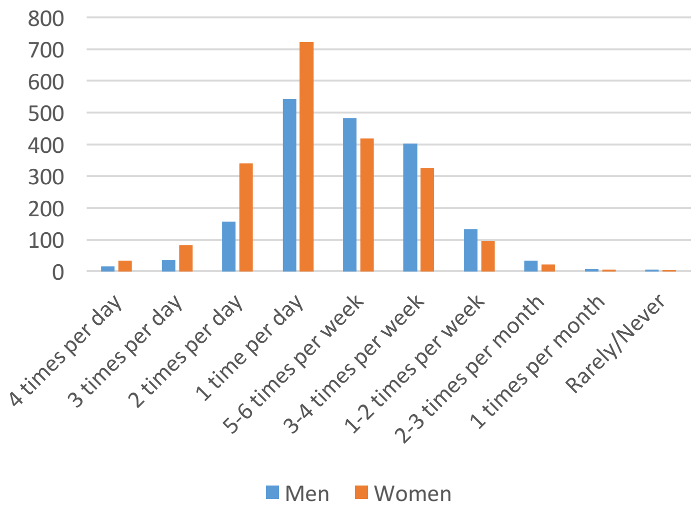

Figure 5::Consumption frequencies of fruits/berries for men and women

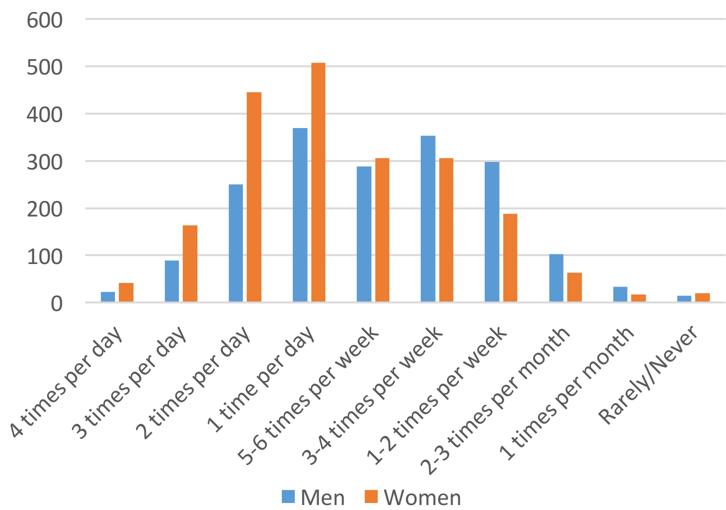

Figure 6:Consumption frequencies of vegetables for men and women

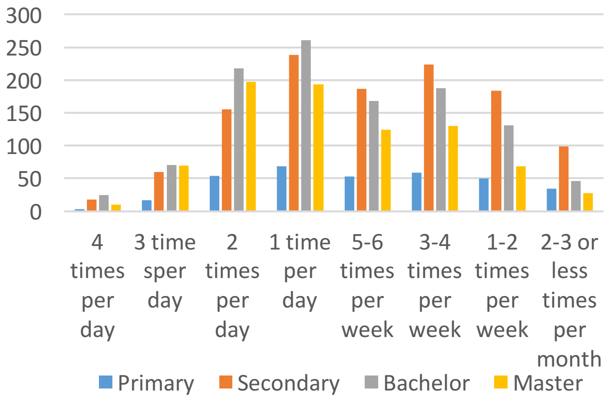

Figure 7: Consumption frequencies of vegetables and educational level

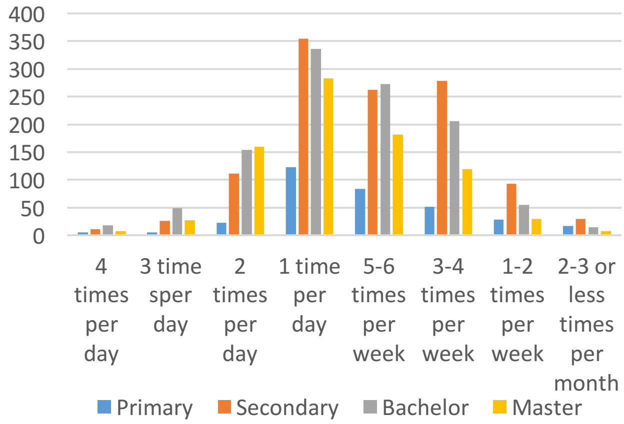

Figure 8: Consumption frequencies of fruits/berries and educational level

5.2 Logistic Regression Analysis

The logistic regression analysis was carried out in STATA 14.2. Table 2 reports the results from the logistic regression for vegetables and Table 3 reports the results from the logistic regression of fruits/berries. The tables show odds ratios and indicate the different significance using asterisks. Because the odds ratio contains no information about the magnitude of the change, marginal effects at mean is calculated and used for further discussion of the results.

5.2.1 Vegetable consumption

Table 2 show the odds ratios for vegetable consumption. The model is fit by including variables group by group. The first model (1) include only the economic variables, in the second model (2) demographic and socioeconomic variables are added, in the third (3) the variables for attitudes and lifestyle choices are added, and finally, in (4), other variables are added. The variables are added group wise to compare the models and examine whether there are noteworthy changes in the variables when controlling for more variables. A likelihood ratio test was used to test joint significance, and used for choosing the model with best fit. All groups except from the economic variables were jointly significant from zero. However, they are kept in the model because they are important variables according to economic theory of demand (McElroy & Horney 1981). The changes in odds of consumption are interpreted as holding other variables constant.

When estimating the first regression (1), price decrease the odds of consuming vegetables at least twice per day with 0.64 and is statistically significant. Income is not significant in any of the models.

When controlling for demographic and socioeconomic variables in the second regression (2), the odds ratio for price is very similar to the odds ratio of price in (1) and still significant. From the added variables are age, female, living in a house with 6 members, master and bachelor degree statistical significant and positively associated with the odds of the outcome, while Eastern, Western, Middle and Northern part of Norway in and age decrease the odds of consuming vegetables twice per day. All household sizes but 6, primary school, marital status and presence of children are not statistically significant for any of the models.

When adding attitudes and lifestyle variables in (3), the association between price and odds of consumption decrease (OR: 0.65 to 0.69) and is still significant. The odds ratio for female decreases from 2.13 to 1.91, while the odds ratio for the other variables from (2) is almost the same. From the added groups is; health conscious and interest for reading magazines about health and diet (magazine) statistically significant and positively associated with the odds of consuming vegetables at least twice per day.

In the final model (4), is price no longer significant. Besides from a vague decrease in some of the variables from (3), and health consciousness (OR reduces from 1.72 to 1.58), are the odds ratios quite similar in (4) and still statistical significant. From the added group, is convenience and taste statistically significant. Caring about convenience and taste when buying food decrease the odds of consumption compared to those who do not care about convenience and taste. Quality, smoker, physical activity, age and all other households sized than 6 are not statistically significant.

From the final model, the variables female increase the odds of consuming vegetables at least twice per day with 1.93. Completed a bachelor or master degree have, respectively, 2.55 and 3.44 higher odds of consuming vegetables at least twice per day. Households size of 6, health consciousness and interest for reading magazines about health and diet increase the odds of consuming vegetables at least twice per day are with respectively 2.12, 1.58 and 1.63. The odds ratio of income is statistically significant, but the association between the variable and outcome is almost 0. Indicating that different ages are equally likely of consuming vegetables at least twice per day. Living Eastern, Western, Middle or Northern par of Norway decrease the odd of consuming vegetables at least twice per day with 0.71, 0.73, 0.51 and 0.47. The variables convenience and taste decrease the odds of consuming vegetable with respectively 0.54 and 0.70.

Table 2: Odds ratios consumption of vegetables

	(1)	(2)	(3)	(4)
Price	0.64**	0.65**	0.69**	0.73*
Income	1.00	1.00	1.00	1.00
Female		2.13***	1.93***	1.93***
Age		0.98***	0.98***	0.97***
Region				
O&A		(ref. group)		
Eastern Nor		0.71***	0.71***	0.71***
Western Nor		0.74**	0.74**	0.73**
Mid-Nor		0.52***	0.51***	0.51***
Northern		0.47***	0.47***	0.47****
Househ. Size				
1		(ref. group)		
2		0.86	0.78	0.74
3		0.95	0.86	0.83
4		0.93	0.83	0.80
5		0.71	0.63	0.60*
6		2.22**	2.07**	2.12**
7		0.80	0.77	0.71
Marital status		1.10	1.22	1.18
Children		0.85	0.91	0.90
Education				
Primary		(ref. group)		
Secondary		1.49*	1.50*	1.52*
Bachelor		2.58***	2.57***	2.55***
Master		3.58***	3.49***	3.44***
Physc Activety			1.21*	1.19*
Smoker			0.83	0.85
Health con			1.72***	1.58***
Magazine			1.65***	1.63***
Convenience				0.54***
Taste				0.70**
Quality				1.05
Norwegian Monitor Survey 2015. All models are fit using 3431 observations.				
*p < 0.1, **p <0.05 ***p< 0.01				
LR chi^2	7.42**	247.38***	320.78***	361.19***
Pseudo R^2	0.0023	0.0779	0.1010	0.1138

5.2.2 Fruits/berries consumption

Estimation of the model for consumption of fruits/berries is done the same way as the model for consumption of vegetables. The same explanatory variables are included and added group wise. A likelihood-ratio test was preformed after adding each group of variable and the joint hypothesis for each group of variables was rejected.

When estimating the first model (1) in Table 3, price is statistical significant and is negatively associated with the odds of consuming fruits/berries at least twice per day. Income is not significant in any of the models.

When controlling for demographic and socioeconomic variables in the second regression (2), the association between price and consumption decrease from 0.56 in to 0.65. From the added variables are; female, household size of 6 and master degree statistical significant and positively associated with the odds of consuming vegetables at least twice per day. Price and living in Northern, Eastern or Middle part of Norway negatively associated with the odds of consumption of vegetables. Western and Middle part of Norway, marital status, children, secondary school and bachelor degree are not statistically significant. Age, Western and Middle part of Norway, all household sizes but 6 and primary school are not statistically significant for any of the models.

When adding attitudes and lifestyle variables in (3), the association between price and odds of the consumption decrease vaguely (OR:0.65 to 0.66) and is still significant. The odds ratio for female decrease from 1.95 to 1.86. The odds ratio for master degree decreases from 1.69 to 1.57. Household size 6 is no longer statistically significant. From the added groups of variables are physical activity, health consciousness and magazine statistical significant and positively associated with the odds of consuming vegetables at lest twice per day. Smoking is also significant, but negatively associated with the odds of consumption.

When adding the final group of variables in regression (4), the association between price and the odds of the outcome decrease (OR: 0.66 to 0.71). The odds ratio for female also decrease from 1.86 to 1.81. The effect of regional differences is almost the same, but now also Middle Norway is statistically significant and decrease the odds of consumption with 0.77. Smoker is no longer statistically significant. For master degree the odds have decreased from 1.57 to 1.52. Physical activity has decreased from 1.30 to 1.28, while health consciousness and magazines have decreased from respectively 1.67 to 1.57 and 1.37 to 1.35. From the added group of variables are convenience and taste statistical significant and negatively associated with the odds of consuming fruits/berries at least twice per day. Convenience decrease the odds of consuming vegetables at least twice per day with 0.72 and taste decrease odds with 0.69.

Table 3: Odds ratios for fruits/berries

	(1)	(2)	(3)	(4)
Price	0.57***	0.65***	0.66***	0.71**
Income	1.00	1.00	1.00	1.00
Female		1.95***	1.86***	1.81***
Age		1.00	1.0	1.0
Region				
O&A		(ref. group)		
Eastern Nor		0.79**	0.79**	0.79**
Western Nor		0.97	0.98	0.97
Mid-Nor		0.79*	0.77*	0.77**
Northern		0.51***	0.52***	0.51***
Househ. Size				
1		(ref. group)		
2		1.22	1.11	1.08
3		1.02	0.91	0.89
4		1.30	1.15	1.12
5		1.12	0.97	0.94
6		1.98**	1.80*	1.80*
7		1.19	1.10	1.06
Marital status		0.86	0.94	0.93
Children		0.87	0.94	0.93
Education				
Primary		(ref. group)		
Secondary		0.93	0.92	0.92
Bachelor		1.31*	1.26	1.23
Master		1.69***	1.57***	1.52**
Physc Activety			1.30***	1.28***
Smoker			0.73**	0.74*
Health con			1.67***	1.57***
Magazine			1.37***	1.35***
Convenience				0.72***
Taste				0.69***
Quality				1.14
Norwegian Monitor Survey 2015. All models are fit using 3431 observations.				
*p < 0.1, **p <0.05 ***p< 0.01				
LR chi^2	19.27	159.74	247.99	273.11
Pseudo R^2	0.0049	0.0405	0.0629	0.0692

5.2.3 Marginal effect at mean

The marginal effects at the mean are presented in Table 3. The marginal effects are calculated holding all other variables at their means.

The result indicates that an individual who think price is the most important factor when buying food, have -0.06 lower probability of consuming fruits/berries twice per day than an individual who does not think that price is the most important factor. For vegetables, price is not significant. The marginal effect of a change in income is not significant for any of the models.

The results reveals that females have 0.08 higher probability of consuming vegetables at least twice per day than men, and 0.11 higher probability of consuming fruits/berries twice per day than men. The results indicate that a change in age have no significant effect on probability of consumption of vegetables or fruits/berries. The probability of consuming vegetables at least twice per day decrease with respectively - 0.04, -0.04, -0.07 and -0.07 if place of residence is Eastern, Western, Middle and Northern part of Norway, compared to O&A. For fruits/berries consumption, a change from O&A to Western part of Norway is not significant, while Eastern, Middle and Northern part of Norway decrease probability with respectively -0.04, -0.05 and –0.11. For vegetables, the change in probability of consuming at least twice per day is -0.05 lower for household with five members compared to one member, and is significant. However, no other household sizes have any effect on probability for vegetables. For fruits/berries, none of the household sizes are statistically significant. The result indicates no difference in probability between individuals who are married and not married, and individuals who have children compared to individuals without children. For a change in educational level from primary school to completed a master degree or bachelor degree, the marginal effects indicate that predicted probability for consumption of vegetables, will increase with 0.13 for a bachelor degree and 0.19 for a master degree. For fruits/berries only a master degree compared to primary school increase probability of consuming fruits/berries at least twice per day, and less than for vegetables (0.08).

Table 4 also indicates that being physical active, compared to those who are not, increase probability of consumption of fruits/berries with 0.05, but does not have significant effect on probability of vegetable consumption. Being a daily smoker, compared to those who are not, decrease the probability of consumption of fruits/berries with -0.05, but is not significant for vegetable consumption. The probability of consumption of both vegetables and fruits/berries twice per day is higher for individuals who are health conscious and read magazines about health and diet compared to people who are not health conscious or uninterested in magazines about health and diet. The increase in probability of consumption for health consciousness and interested in reading magazines about health and diet is, respectively, 0.06 and 0.07 for vegetables and 0.09 and 0.06 for fruits/berries.

Whereas, individuals who think taste and convenience is important when buying food have lower probability of consuming vegetables and fruits/berries compared to individuals who don’t care about convenience and taste is important when buying food. The probability of consuming vegetables twice per day is respectively -0.07 and -0.04 less for a person who care about convenience and taste when they buy food. For fruits/berries the probability of consuming at least twice per week, decrease with - 0.06 for both factors. It appears not to be a difference in probability of consuming vegetables and fruits/berries between people who care about quality when buying food and those who do not care about quality when buying food,

Table 4: Marginal effects at mean for vegetables and fruits/berries

	Vegetables	Fruits/berries
Price	-0.04*	- 0.06**
Income	0.00	0.00
Female	0.08***	0.11***
Age	- 0.00***	- 0.00
Region		
O&A	(ref.group)	
Eastern Nor	- 0.04***	- 0.04**
Western Nor	- 0.04**	- 0.01
Mid-Nor	- 0.07***	- 0.05**
Northern	- 0.07***	- 0.11***
Househ. Size		
1	(ref.group)	
2	- 0.04*	0.01
3	- 0.02	- 0.02
4	- 0.03	0.02
5	- 0.05**	- 0.01
6	0.12*	0.12
7	- 0.05	0.01
Marital status	0.02	- 0.01
Children	- 0.01	- 0.01
Education		
Primary	(ref. group)	
Secondary	0.05*	- 0.02
Bachelor	0.13***	0.04
Master	0.19***	0.08**
Physical Activity	0.02*	0.05***
Smoker	- 0.02	- 0.05**
Health con	0.06***	0.09***
Magazine	0.07***	0.06***
Convenience	- 0.07***	- 0.06***
Taste	- 0.04**	- 0.06***
Quality	0.01	0.02

6. Discussion

In spite of the evidence on the numerous health benefits from consuming adequate levels of F&V, is the current consumption level below the recommenced levels. The alarming rates of noncommunicable diseases caused by unhealthy diets support the urgency for promoting healthy diets (World Health Organization 2017). Norway have committed to follow WHOs global strategy for diet and physical health to reduce premature deaths caused by noncommunicable diseases (Helsedirektoratet 2016). Consuming at least 500 gram of F&V per day, half of vegetables and half of fruits/berries, is considered an essential part of an overall healthy diet and important factor for reducing the probability of getting sick.

This study aimed at discovering characteristics, attitudes and lifestyle choices that is related to high consumption frequencies of F&V and identify potential factors that should be included in designing efficient policy instruments. Strategies to increase consumption levels of F&V could yield significant health benefits if targeted at the right areas. The analysis showed that only 26.2% and 17.4% of the respondents in the sample consume fruits/berries or vegetables at least twice per day, respectively. This confirms the findings from dietary surveys which reveals that the majority of the population falls short of the targets set by The Department of Health (Totland et al. 2012). These findings highlight the continued need for developing policy interventions that effectively lead to healthier dietary choices.

According to theory of demand, a rise in income will increase demand for a given good and an increase in price will decrease demand, holding everything else constant (McElroy & Horney 1981). Findings from previous studies on F&V consumption in relation to this theory is mixed. Rickertsen (1995) and Rickertsen et al. (1998) coincides with the theory in relation to price. Øvrum & Rickertsen (2015) did not find such a relationship between income and consumption, while Rickertsen (1994) and Rickertsen (1995) found that an increase in income increased consumption. The findings from this analysis indicates that price and income have no effect on the probability of consuming vegetables at least twice per day. For consumption of fruits/berries, price was significant and indicates a decrease in probability of 0.06 if the individual think that price is the most important factor when buying food. However, it has to be taken into account that the price variable used in this analysis is only a measure of the subjective opining about the importance of price when buying food and does not measure actual effect of changes in price. These results imply that a price policy would only have an effect on consumption of fruits/berries.

The descriptive analysis (Figure 4) showed clear differences between the proportion of women and men consuming vegetables or fruits/berries at least twice per day. This result was supported by the logistic regression analysis and the calculation of the marginal effects which indicates that probability of consuming vegetables and fruits/berries at least twice per day is respectively 0.08 and 0.11 higher for women than for men. This results also coincides with previous studies and could possible be effected through nutrition information campaigns that especially target men.

Findings in previous literature have found both significant and a vague association, between consumption and age. Øvrum (2010) and Øvrum, A & Rickertsen (2015) found a vague increase in consumption of F&V with increasing age, while Totland et al. (2012) did not find a significant difference between ages. The results from this analysis does not indicate significant relationship between consumption of fruits/berries and age. Age is statistically significant for consumption of vegetables, but the odds ratio indicates almost no association between age and the odds of consumption. Also the marginal effect of a change in age is almost 0.

Some studies abroad have found that consumption levels of F&V in rural areas is lower than in urban areas and may indicate there are different factors between regions that effect consumption levels. This was the reason for investigating potential differences between regions in Norway. The regression analysis indicates that individuals living in other regions than O&A are less likely to consume vegetables and fruits/berries twice per day compared to individuals living in O&A The probability of consuming vegetables and fruits/berries at least twice per day decreases if place of residence is in Eastern, Middle or Northern part of Norway. The probability vegetables consumption also decreases if place of residence is in Western part of Norway. For vegetables the decrease is -0.07 for both Middle and Northern Norway. It seems that the further North you live, probability of consuming vegetables and fruits/berries at least twice per day decrease. The effect on probability of place of residence is for consumption of fruits/berries and is -0.11 for living in Northern part of Norway.

Some studies have also emphasized the positive effect of eating together on the consumption of F&V (Azagba & Sharaf 2011, Totland et al. 2012, Wandel 1995). The logistic regression analysis indicated that a household with 6 members are less likely to consume vegetables and fruits/berries than a household with only one member. But, none of the other household sizes are significant.

The descriptive analysis showed clear differences between consumption levels and educational level. This was also the factor that show largest effect on the change in probability of consuming vegetables. A masters or bachelor degree compared to primary school increase probability of consuming vegetables at least twice per day with respectively 0.13 and 0.19. For consumption of fruits/berries, only a master degree was significantly different from primary school with a predicted increase in probability with 0.08. This consist with findings in research from all over the world, except countries where consumption is already high (Irala-Estévez, et al., 2000; Roos, et al., 2000).

Results from this analysis, indicates that a healthy lifestyle and attitudes have positive effect on consumption of vegetables and fruits/berries (Johansson & Andersen 1998, Opplysningskontoret for frukt og grønt 2015, Nijemeijer et al. 2004, and Totland et al. 2012), Totland et al. (2012) found that people who are concerned about maintaining a healthy diet where more likely to have high consumption of F&V. The marginal effect in probability for a change from not health conscious to health conscious is 0.06 and smaller for consumption of vegetables than for fruits/berries, which is 0.09. Likewise, are individuals who are interested in reading about health and diet a little more likely to consume vegetables (0.07) than fruits/berries (0.06) at least twice per day then individuals who are not interested. This indicates that increasing health consciousness in the population could have a positive effect on consumption of F&V.

Increasing health consciousness could be done through advertising, health campaigns and labeling. Due to the fact that only 24% percent men and 41% women consumed the recommended consumption level of fruits, and 15% women and 13% consumed the recommended level of vegetables in 2010-2011 (Totland et al. 2012), increasing awareness of the dietary advices and the potential benefits of not maintaining a healthy diet should be a part of this. The data set did not include a variable for this so I was not able to examine the effect of this factor. Further studies should investigate whether increasing knowledge in the Norwegian population could be an effective way to increase consumption levels.

Previous studies have found that taste and convenience are potential barriers for consuming F&V (Bugge 2015, Nijemeijer et al 2004, Opplysningskontoret for frukt og grønt 2015). For the sample used for this analysis (see Figure 3), a large share of the respondents reported that taste was on of the most important factor when buying food. Convenience does not seem to be a very important factor compared to the others. This analysis also found negative association between taste and convenience and probability of consuming vegetables and fruits/berries. According to the marginal effect analysis, probability of consuming vegetables and fruits/berries at least twice per day decrease with respectively -0.07 and -0.06 if convince is important when buying food, compared to not. Also, if taste is important when buying food compared to not important, predicted probability of consuming vegetables and fruits/berries at least twice per day decrease with -0.04 and -0.06 respectively. Improving in this area could be to offer more pre-cut and packed F&V and fast food with higher content of F&V, and create a better reputation for F&V and taste.

Another barrier for consumption of F&V found in previous studies is quality. Opplysningskontoret for frukt og grønt (2015) stated in *Totaloversikten 2016*, that quality was one of the main barriers for not consuming vegetables. However, this study did not indicate that there is a difference in probability of consuming vegetables and fruits/berries at least twice per day between individuals that think quality is important and those who do not. This analysis did also not find characteristics and attitudes such as marital status, presence of children, physical activity and smoker to have impact on the probability of consuming vegetables twice per day. For the probability of consuming fruits/berries, the analysis indicates that individuals who are physical active have 0.05 higher probability of consuming fruits/berries at least twice per day, compared to individuals who are not physical active and individuals that smoke, compared to individuals that do not smoke, are -0.05 less probability of consuming fruits/berries at least twice per day.

6.1 Limitations

The current analysis has some limitations. Firstly, the consumption variables are based on survey questions that measures frequencies of consumption and may not reflect actual quantity consumed. The data may also have measurement error because the consumption frequencies are self-reported. Secondly, the estimation is based on results from one year, which result in little variation in the sample. Thirdly, some the factors are underrepresented in terms of observations and might effect the results and cause bias. The descriptive analysis showed quite even proportion of respondents from O&A, Eastern par of Norway, Western part of Norway and Mid-Norway, but the portion of respondents from Northern part of Norway is underrepresented. Also, the group of respondents that have only completed primary school and respondents with household 5, 6 and more than 6 was very small compared to the other subgroups. Another possible limitation is that it is not taken into account that it might exist different subpopulations within the overall population. For example, Gustaven & Rickertsen (2013) found that removing VAT has more effect on reducing consumption of unhealthy foods for high-consumers than it has on increasing consumption of healthy food for low-consumers. It can also be that in one subpopulation education increase health consciousness while in another subpopulation it leads to inactive jobs and less time to focus on eating healthy. There are also potential problems with using marginal effects at the means for analyzing the change in probability. Most of the explanatory variables are dichotomous and it does not make much sense to talk about somebody who is 34% health conscious or 53% female.

Interval regression could have been used to investigate the effects of the determinants in more detail, but due to time constraint I did not have time to go further into interpretation of this model. However, I did estimate the interval regression for vegetables and fruits/berries and the results are added in the appendix (Table 7). The effects of the variables are similar to the results of the logistic regression and the same variables are significant.

7. Conclusion

This analysis introduces logistic regression analysis to the context of characteristics, attitudes and lifestyle choices and consumption of F&V. In previous studies, economic variables are typically found to have impact on consumption behavior. The results of the logistic regression in this study did not find that price and income have effect on probability of consuming vegetables. It did, however, find that price is negatively related to consumption of fruits/berries, but income was also significant for fruits/berried. However, economic theory strongly indicate that economic factors are important in consumer behavior and studies on the use of taxes and subsidies have found that they can have an effect if targeted at the right areas

In conclusion, does this analysis find several factors that can effect the probability of consumption. Successfully improving the dietary pattern of the Norwegian people will need further investigation of the drivers behind consumption of F&V. In particular, does higher level of education and being women appear to have positive impact on probability of consuming vegetables, while living in Middle or Northern part of Norway have negative impact. The results also indicate that increasing health consciousness, making F&V more convenient to consume and give F&V a more positive reputation could potentially contribute to increase consumption. An increase in health consciousness could be achieved through advertising and spreading information and awareness about health benefits from F&V consumption through campaigns. It is clearly a need for creating policy intervention that especially target men. Convenience could be solved by introducing more cut and pre-packed F&V. Subsidizing the cost of F&V and reducing VAT may be in helpful promoting consumption of fruits/berries.

Several limitations of this study have been pointed out and further investigation of the determinants behind consumption of F&V is needed. Studies based on data from several periods that track the same individual and his lifestyle could be helpful in gathering a comprehensive understanding of consumption pattern. There should also be further investigation of why consumption levels of F&V are more likely to be lower in Middle and Northern part of Norway.

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Appendix

Table 5: Logit model for consumption of vegetables (log odds)

	(1)	(2)	(3)	(4)
Price	- 0.44**	- 0.43**	- 0.40**	- 0.32*
Income	- 0.00	0.00	0.00	0.00
Female		0.75***	0.66***	0.66***
Age		- 0.02***	- 0.03***	- 0.03***
Region				
O&A		(ref. group)		
Eastern Nor		- 0.35***	- 0.34***	- 0.35***
Western Nor		- 0.30**	- 0.31**	- 0.31**
Mid-Nor		- 0.65***	- 0.68***	- 0.68***
Northern		- 0.75***	- 0.76***	- 0.76***
Househ. Size				
1		(ref.group)		
2		- 0.16	- 0.25	- 0.30
3		- 0.05	- 0.16	- 0.18
4		- 0.07	- 0.19	- 0.22
5		- 0.34	- 0.46	- 0.51*
6		0.80**	0.72**	0.75**
7		- 0.22	- 0.26	- 0.34
Marital status		0.10	0.20	0.17
Children		- 0.16	- 0.10	- 0.11
Education				
Primary		(ref. group)		
Secondary		0.40*	0.41*	0.43
Bachelor		0.95***	0.94***	0.95***
Master		1.27***	1.25***	1.24***
Physc Activety			0.19*	0.17*
Smoker			- 0.18	- 0.16
Health con			0.54***	0.46***
Magazine			0.50***	0.49***
Convenience				- 0.62***
Taste				- 0.36**
Quality				0.05

Norwegian Monitor Survey 2015. All models are fit using 3431 observations.
*p < 0.1, **p <0.05 ***p< 0.01

LR chi^2	4.42**	247.38***	320.78***	361.19***
Pseudo R^2	0.0023	0.0779	0.1010	0.1138

Table 6: Logit model for consumption of fruits/berries (log odds)

	(1)	(2)	(3)	(4)
Price	-0.56***	-0.43***	- 0.41***	- 0.35**
Income	0.00	0.00	0.00	0.00
Female		0.67***	0.62***	0.59***
Age		0.0	- 0.00	- 0.00
Region				
		(ref. group)		
O&A		-0.24**	- 0.23**	
Eastern Nor		-0.03	- 0.02	- 0.23**
Western Nor		-0.23*	- 0.26*	- 0.03
Mid-Nor		-0.67***	- 0.66***	- 0.27**
Northern				- 0.67***
		(ref.group)		
Househ. Size				
		0.20	0.11	
1				
		0.03	- 0.09	
2		0.26	0.14	0.07
3		0.11	- 0.03	- 0.11
4		0.68**	0.59*	0.12
5		0.17	0.10	- 0.05
6		0.02	- 0.06	0.59*
7		-0.15	- 0.07	0.05
		-0.13		
Marital status				- 0.07
Children		(ref.group)	- 0.09	- 0.07
Education		-0.08	0.23	
Primary		0.27*	0.45***	
Secondary		0.52***	0.26***	- 0.09
Bachelor			- 0.31**	0.29
Master			0.51***	0.42**
			0.31***	
Physc Activety				0.25***
Smoker				- 0.30*
Health con				0.45***
Magazine				0.30***
Convenience				- 0.32***
Taste				- 0.37***
Quality				0.13

Norwegian Monitor Survey 2015. All models are fit using 3431 observations.
*p < 0.1, **p <0.05 ***p< 0.01

LR chi^2	19.27	159.74	247.99	273.11
Pseudo R^2	0.0049	0.0405	0.0629	0.0692

Table 7: Interval regression for vegetables and fruits/berries

	Vegetables	Fruits/berries
Price	- 23.27*	- 39.95**
Income	- 0.01	0.02
Female	59.44***	99.63***
Age	- 0.98***	0.62*
Region		
O&A	(ref.group)	(ref.group)
Eastern Nor	- 48.34***	- 37.21**
Western Nor	- 29.60***	- 6.40
Mid-Nor	- 61.10**	- 32.54*
Northern	- 64.66***	- 85.60***
Househ. Size		
1	(ref. group)	(ref.group)
2	- 2.07	13.21
3	- 12.20	- 24.80
4	7.52	8.43
5	- 27.71	- 16.11
6	127.47.25***	94.68*
7	- 25.77	- 4.49
Marital status	7.2	- 3.42
Children	- 0.04	7.10
Education		
Primary	(ref.group)	(ref.group)
Secondary	15.07	6.02
Bachelor	57.99***	44.69**
Master	77.75***	72.92***
Physc Activety	17.49**	48.46***
Smoker	- 11.21	- 49.96***
Health con	50.47***	71.09***
Magazine	54.76***	55.63***
Convenience	- 68.47***	- 51.25***
Taste	- 35.16***	- 44.31***
Quality	1.69	16.10
Constant	392.53***	287.28

Multicollinearity test

	hhz3	hhz4	hhz5	hhz6	hhz7	relati~p	children	educ2	educ3	educ4	training
hhz3	1.0000										
hhz4	-0.1737	1.0000									
hhz5	-0.1228	-0.1277	1.0000								
hhz6	-0.0522	-0.0543	-0.0383	1.0000							
hhz7	-0.0377	-0.0392	-0.0277	-0.0118	1.0000						
relationship	0.0173	0.1200	0.0753	-0.0162	-0.0469	1.0000					
children	0.3605	0.4684	0.3281	0.1130	0.0574	0.1320	1.0000				
educ2	0.0023	-0.0124	-0.0278	-0.0131	0.0212	-0.0907	-0.0757	1.0000			
educ3	0.0049	-0.0056	-0.0035	0.0013	-0.0228	0.1102	0.0089	-0.4945	1.0000		
educ4	-0.0118	0.0263	0.0156	-0.0224	-0.0367	0.1139	0.0399	-0.4012	-0.3859	1.0000	
training	-0.0231	-0.0291	0.0060	-0.0033	-0.0063	-0.0737	-0.0499	-0.0285	0.0134	0.0228	1.0000
smoker	-0.0302	-0.0653	-0.0504	-0.0283	-0.0210	-0.0378	-0.0689	0.0520	-0.0042	-0.0764	-0.0666
healthcon	-0.0223	-0.0364	-0.0134	-0.0087	-0.0195	-0.0301	-0.0614	-0.0544	0.0016	0.0614	0.3125
mag	0.0068	-0.0119	-0.0206	0.0017	0.0034	-0.0457	-0.0130	-0.0203	0.0210	0.0039	0.1086
convenience	0.0207	0.0188	0.0002	0.0429	0.0262	-0.1216	0.0407	0.0506	-0.0296	-0.0219	-0.0384
taste	0.0330	0.0261	0.0026	-0.0081	-0.0077	-0.0357	0.0225	0.0816	-0.0487	-0.0757	-0.1070
quality	-0.0203	-0.0373	-0.0484	-0.0350	-0.0379	0.0232	-0.0583	-0.0842	0.0066	0.1069	0.0255

	y2	y1	price	inc	woman	age	r2	r3	r4	r5	hhz2
y2	1.0000										
y1	0.3958	1.0000									
price	-0.0445	-0.0668	1.0000								
inc	0.0098	0.0361	-0.1218	1.0000							
woman	0.1527	0.1432	-0.0309	-0.2192	1.0000						
age	-0.1119	0.0200	-0.1250	0.2274	-0.0695	1.0000					
r2	-0.0323	-0.0275	-0.0121	-0.0472	-0.0086	0.1084	1.0000				
r3	-0.0036	0.0267	0.0109	0.0316	-0.0088	-0.0346	-0.3580	1.0000			
r4	-0.0442	-0.0209	0.0063	-0.0587	-0.0229	-0.0434	-0.2617	-0.2340	1.0000		
r5	-0.0448	-0.0664	0.0370	-0.0113	-0.0216	-0.0157	-0.1987	-0.1777	-0.1299	1.0000	
hhz2	-0.0331	0.0145	-0.0201	-0.0273	-0.0542	0.2616	0.0165	-0.0220	-0.0040	-0.0136	1.0000
hhz3	0.0185	-0.0313	0.0233	-0.0043	0.0223	-0.1701	-0.0173	-0.0273	0.0243	0.0114	-0.3253
hhz4	0.0245	0.0085	-0.0056	0.0861	-0.0056	-0.2162	-0.0109	0.0202	0.0031	-0.0089	-0.3384
hhz5	-0.0181	-0.0152	-0.0110	0.0471	-0.0233	-0.1575	-0.0356	0.0596	0.0315	-0.0018	-0.2392
hhz6	0.0637	0.0296	0.0218	-0.0278	0.0332	-0.1068	0.0014	0.0307	-0.0002	0.0005	-0.1016
hhz7	-0.0005	-0.0043	0.0351	-0.0473	0.0178	-0.0933	0.0050	0.0072	-0.0201	-0.0067	-0.0735
relationship	-0.0061	0.0049	-0.0686	0.2669	-0.0595	0.2283	0.0196	0.0096	0.0047	-0.0012	0.3965
children	0.0245	-0.0130	0.0172	0.1349	0.0195	-0.3289	-0.0129	0.0418	0.0069	-0.0172	-0.5098
educ2	-0.0893	-0.1007	0.1089	-0.2432	-0.0816	-0.1504	-0.0069	0.0380	0.0521	0.0267	0.0001
educ3	0.0464	0.0320	-0.0497	0.0562	0.0784	0.0574	0.0011	-0.0032	-0.0115	0.0037	0.0332
educ4	0.0945	0.0963	-0.0838	0.3767	-0.0043	0.1441	-0.0452	-0.0405	-0.0222	-0.0226	-0.0061
training	0.0721	0.0975	-0.0221	-0.0048	-0.0058	-0.0176	-0.0247	-0.0088	0.0390	-0.0002	0.0142
smoker	-0.0635	-0.0661	0.0129	-0.0011	0.0090	0.1134	0.0421	-0.0102	-0.0139	0.0332	0.0265
healthcon	0.1162	0.1472	-0.0308	0.0132	0.0112	0.0854	-0.0178	0.0069	0.0189	-0.0091	0.0332
mag	0.1366	0.1186	-0.0243	-0.0618	0.2716	-0.0061	-0.0103	0.0071	-0.0036	-0.0137	-0.0023
convenience	-0.0864	-0.0759	0.0971	-0.0160	0.0329	-0.1414	-0.0174	0.0170	0.0061	-0.0120	-0.1071
taste	-0.0825	-0.1062	0.0572	-0.0411	-0.1086	-0.1132	0.0153	-0.0306	-0.0040	0.0322	-0.0309
quality	0.0201	0.0595	-0.1413	0.0973	0.0627	0.1892	0.0064	-0.0493	0.0078	0.0176	0.0491

	smoker	health~n	mag	conven~e	taste	quality
smoker	1.0000					
healthcon	-0.1468	1.0000				
mag	-0.0671	0.1662	1.0000			
convenience	0.0082	-0.0872	-0.0129	1.0000		
taste	0.1007	-0.1876	-0.0899	0.0670	1.0000	
quality	0.0452	0.0677	0.0116	-0.1100	-0.0173	1.0000

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