HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

FOOD LITERACY

HEALTH AND ENVIRONMENTAL KNOWLEDGE OF UPPER SECONDARY SCHOOL STUDENTS

FANNY AAPIO

University of Helsinki
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HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

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Food literacy is a noteworthy topic to be studied due to food's considerable environmental and health effects. When food literacy and its characteristics are known, food literacy can be used as a tool to improve people's health and the condition of the environment. Thus, this thesis aims to reveal the extent of food literacy among Finnish upper secondary school students. In this context, food literacy emphasises food-related environmental and health knowledge. Environmental knowledge is understanding of the global environmental impact of food. Health knowledge, on the other hand, is the familiarity with the relationship between excessive meat consumption and Finnish common diseases along with beliefs regarding diets and food products as a source of protein. This thesis also aims to identify to what extent does the food literacy differ based on gender, study year and living area.

This study was performed as a quantitative sample survey and the data was collected using an online Typeform -questionnaire. The questionnaire reached respondents from many different Finnish localities, mainly from cities. The final data consisted of 1320 individuals and it was analysed using IMB SPSS Statistics 24 software. The following methods were used to analyse data: frequency analysis, an Independent Samples t Test, a One-way ANOVA, and a Post-hoc LSD test. Gender, study year and living area were used as grouping variables to examine the differences between groups.

The results show that the students named school as the main source of food literacy. Moreover, the results indicate that awareness regarding food production, dietary health and proteins increase significantly from the first to the third study year. The students acknowledged food production causing environmental problems and that the share of food in the consumer's climatic impact is considerable. Nevertheless, the students underestimated the climatic impact of cheese and they were unaware of the more specific characteristics of food's environmental impacts. They also had food-related environmental misconceptions considering packaging, transportation and meat consumption. Moreover, approximately half or more of the students were aware of the connection between excessive meat consumption and the increased risk of distinct common diseases. Most of the students acknowledged a versatile vegetarian diet as being a healthy choice. The study also reveals that female students had notably higher dietary health knowledge than male students.

This Master's thesis study mainly supports the findings of previous studies on food-related knowledge. The results elucidate the extent, characteristics, gaps and misconceptions of students' food literacy. These findings may be utilized to improve school education on food literacy, alter misconceptions and fill the gaps of knowledge in pursuit of improving the health of people and the condition of the environment.

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Food literacy, food, diet, environment, health, knowledge, upper secondary school

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HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

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Ruokalukutaito on tärkeä tutkimuskohde, sillä ruoalla on merkittäviä terveys- ja ympäristövaikutuksia. Kun ruokalukutaidon ominaispiirteet tunnetaan, voidaan sitä käyttää välineenä paremman terveyden ja ympäristön hyvinvoinnin saavuttamiseksi. Tämä maisterintutkielma pyrkii selvittämään lukiolaisten ruokalukutaidon laajuutta, missä korostuvat ruokaan liittyvät terveys- ja ympäristötietämys. Tutkielmassa ympäristötietämys on ymmärrystä ruoantuotannon ja -kulutuksen maailmanlaajuisista ympäristövaikutuksista. Terveystietämys on puolestaan ymmärrystä liiallisen lihankulutuksen ja suomalaisten kansantautien suhteesta sekä uskomuksia ruokavaliosta ja eri tuotteiden proteiinipitoisuuksista. Tämä maisterintutkielma pyrkii myös tunnistamaan, miten ruokalukutaito eroaa eri sukupuolten, opintovuosien ja asuinympäristöjen välillä.

Tutkimus suoritettiin kvantitatiivisena otantatutkimuksena ja aineisto kerättiin käyttäen Typeform -kyselypohjaa. Kysely tavoitti vastaajia eri asuinympäristöistä – pääasiassa suomalaisista kaupungeista. Lopullinen aineisto koostui 1320 vastaajasta ja aineisto analysoitiin IMB SPSS Statistics 24 ohjelmiston avulla. Aineiston analysoinnissa käytettiin frekvenssianalyysia, riippumattomien otosten *t*-testiä, yksisuuntaista varianssianalyysia sekä Fisherin LSD-testiä. Sukupuolta, opintovuotta ja asuinympäristöä käytettiin luokittelevina muuttujina ryhmien välisten erojen selvittämiseksi.

Tulokset osoittavat, että lukiolaisten mukaan koulu on heille pääasiallinen ruokalukutaidon lähde. Tulokset myös kuvaavat, että tietämys ruoantuotannosta, ruokavalion terveysvaikutuksista sekä eri tuotteiden proteiinisisällöstä lisääntyy tilastollisesti merkitsevästi ensimmäisestä opintovuodesta kolmanteen opintovuoteen. Tulosten mukaan lukiolaiset tiedostivat ruoantuotannon aiheuttavan ympäristöongelmia, ja että ruoan osuus yksittäisen kuluttajan tuottamista kasvihuonekaasuista on huomattava. Oppilaat kuitenkin aliarvioivat juuston ilmastovaikutuksen, eivätkä olleet tietoisia yksityiskohtaisemmista ruoan ympäristövaikutuksista. Lukiolaisilla oli myös väärinkäsityksiä ruoan pakkaamisen ja kuljetuksen sekä lihankulutuksen vaikutuksista. Näiden tulosten lisäksi vain noin puolet tai hieman useampi oppilaista oli tietoisia siitä, että runsas punaisen lihan ja lihavalmisteiden kulutus lisäävät riskiä sairastua erilaisiin kansantauteihin. Suurin osa kuitenkin tiedosti monipuolisen kasvisruokavalion olevan terveellinen vaihtoehto. Huomionarvoista on myös se, että naispuolisilla oppilailla oli korkeampi terveystietämys kuin miespuolisilla oppilailla.

Tämä maisterintutkielma tukee pääasiassa aikaisempien tutkimusten tuloksia koskien ruokalukutaitoon liittyvää terveys- ja ympäristötietämystä. Tulokset antavat entistä tarkemman kuvan oppilaiden ruokalukutaidon laajuudesta ja ominaispiirteistä sekä tuovat esiin tietämyksen aukkoja ja väärinkäsityksiä. Tuloksia voidaan hyödyntää koulun ruokalukutaidon opetuksessa, väärinkäsitysten muuttamisessa ja tiedon lisäämisessä pyrittäessä parantamaan ihmisten terveyttä ja ympäristön tilaa.

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ruokalukutaito, ruoka, ruokavalio, ympäristö, terveys, tietämys, lukio

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1. Introduction

This thesis explores food literacy among Finnish upper secondary students from the point of view of environmental sciences, and it is conducted in association with the World Wide Fund for Nature (WWF). Food is a noteworthy issue, as evidence suggests food having environmental and health effects (see Appendix 1 and 2 for details). Globally, food is one of the three most considerable factors of the individual consumption, together with driving and dwelling, in creating environmental problems (Seppälä et al., 2009). Most of the environmental impact of food is caused by primary production, especially agriculture (Mottet et al., 2017; Riipi & Kurppa, 2013), and for example, livestock production is responsible for approximately 18% of anthropogenic greenhouse gases (Steinfeld et al., 2006). Since diet and environment are connected, a change in a diet towards consuming less meat would decrease the environmental impact of food consumption and production (Dagevos & Voordouw, 2013; Poore & Nemecek, 2018). In addition to environmental impact, research on health indicates that people who consume large quantities red and processed meat have a higher incidence of colorectal cancer, type II diabetes, obesity and coronary artery disease (see Appendix 2).

Although there are clear health and environmental benefits to changing one's diet, many cultures and social groups regard meat as a nutritionally valuable ingredient, the main source of protein, and a tasty and essential part of a diet. In these cultures, reducing meat consumption may be considered exceptional, causing nutritional deficiencies and lack of protein as well as renouncing the pleasure of eating meat (Bohm et al., 2015). On the other hand, people also know about the health-improving impacts of vegetarianism (Lea & Worsley, 2003b). Despite food-related information being available, it is unclear, what the real level of food literacy is.

Food literacy, in this case, food-related understanding, information and critical knowledge (Truman et al., 2017), needs to be studied as there is a lack of previous research on health knowledge that focuses on the connections between food and diseases and food-related environmental knowledge (Pohjolainen et al., 2016). When the extent and characteristics of food literacy are known, food-related misconceptions and gaps can

be revealed. When the fallacies and gaps are revealed, it is possible to channel resources to alter them and strengthen food literacy. The idea of food literacy can be utilized when seeking improvement in the health of people and the condition of the environment (Truman et al., 2017).

It can be argued that food is a trending topic in Finland. Food, especially food that contains less meat, has been one of the hot topics of public discussion during recent years which is why food literacy is an interesting topic to be studied. For example, in 2018 a vegetarian day for the Finnish defence forces raised discussion for and against. The vegetarian day was argued for on grounds of climate change and healthiness (Keränen, 2018) whereas counterarguments questioned the protein content of vegetarian food and the environmental friendliness of imported soy (Miikkulainen & Autio, 2018; Palokallio, 2018). However, it may be possible that there is a change happening in Finnish society. For example, plant-based alternatives and their popularity have increased in grocery stores (see e.g. Mäki-Petäjä, 2019; Pitkänen, 2018; Ziemann, 2016).

Moreover, food literacy is an interesting topic to be studied in relation to upper secondary students. Upper secondary students represent young people, which is an important group to be studied since students are present-day and future consumers and are likely to be the leaders in the future. The students are becoming independent and moving away from their childhood homes (Mäkiniemi & Vainio, 2014) and starting to make their own consumption choices. Moreover, they are a quite mixed group, in comparison to students in vocational schools, as the students have not yet divided into particular career paths based on their interests. This diversity is an advantage when the findings and results of this research are generalized to a wider population of upper secondary school students. Lastly, it is intriguing to study food literacy of students as environmental activity among young people around the world has risen. For example, climate change has become a part of young actors' agenda (Onali, 2019; Seppälä & Hevonoja, 2019; Sirén et al., 2019).

The main research questions of this study are:

RQ1. To what extent are upper secondary students aware of the environmental impacts of food?

RQ2. To what extent are upper secondary students aware of the health impacts of food?

RQ3. To what extent does the knowledge of these issues differ based on gender, study year and living area?

The literature section of this thesis describes the term food literacy and previous studies published on food-related knowledge on general level, as there is a lack of studies on upper secondary students' food literacy. Moreover, previous food-related studies are accompanied by newspaper articles and other sources, which are used mostly to highlight the actual and current public discussion on the topic. Previous studies on food literacy are followed by presenting, how food-related issues are implemented in the Finnish curriculum regarding upper secondary schools. The method section describes how the food literacy of the students was studied and how the data was acquired. The results reveal the extent of food literacy of the upper secondary students and statistically significant differences between previously mentioned groups. The discussion focuses on the interesting findings of student's food literacy and the differences between groups, which are accompanied by possible explanations behind these findings. This is followed by a conclusion, which presents the results in terms of the school curriculum and the limitations of this thesis.

2. Literature review

2.1 Food literacy

Food literacy is a wide term with many definitions, which vary according to users. According to a scoping review of Truman et al. (2017), food literacy generally consists of six distinct domains, from which this thesis focuses on knowledge and food systems. Knowledge includes the capability to interpret and search for food-related information and it can be divided into critical and functional knowledge. Many studies have emphasised especially critical knowledge, which contains the understanding of food and food-related issues and information. Furthermore, it refers to the acquisition of different food-related information, such as nutritional knowledge. In turn, functional knowledge as an object of study has not gained as much interest in the field of research as critical knowledge. As critical knowledge emphasised understanding of food-related issues, functional knowledge accentuates skills and employing the food-related information into action (Truman et al., 2017). Like the previous studies, this thesis will focus on critical knowledge and excludes functional knowledge. Besides knowledge, the other domain of interest is food systems. Food systems, as a domain of food literacy, characterises interpreting the complex nature of food systems, which includes, for example, the environmental effects of food (Truman et al., 2017). In this thesis, the environmental effects of food include the effects of food production and consumption.

In this thesis, food literacy emphasises food-related critical environmental knowledge and critical health knowledge, which are measured statistically, even though measuring food literacy is demanding (Truman et al., 2017). Environmental knowledge includes the understanding of various food choices' creating dissimilar pressures on the environment, awareness of food production's impact on food systems and consciousness of different food products' greenhouse gas (GHG) emissions. As environmental knowledge emphasises awareness of the connection between food production and consumption and the environment, critical health knowledge, on the other hand, accentuates health risks related to food consumption, especially in relation to different diets. Besides health risks, this thesis emphasises food-related protein knowledge, as meat is generally considered as the main source of protein (Bohm et al., 2015) and because people who oppose vegetarian

food, tend to argue against it with the lack of protein, such as in the case applying a vegetarian day in certain Finnish schools (Junnilainen, 2011).

2.2 Previous studies on food literacy

There is little knowledge on whether people connect food production to decreasing biodiversity, whether people consider meat and plant production equally polluting and requiring the same amount of land area, whether they are aware of the climatic impact of different food products such as beef, cheese, peas and soy. However, previous studies on the environmental impacts of food include two domains of food literacy, knowledge and food systems. Preceding studies presented here are related for example to awareness of food and climate, food waste, packaging, a reduction in meat consumption, transportation and favouring organic products. This thesis examines the awareness of all these above-mentioned issues.

There are previous studies, that can be considered as studies on food literacy. These studies suggest that people are familiar with some aspects of foods' environmental impact, although, in a previous study of consumer consciousness on meat and the environment by Pohjolainen et al. (2016), the researchers claim that only 35.6% of respondents agreed that food production causes notable environmental problems. However, people are generally aware that food waste has considerable effects on the environment (Katajajuuri et al., 2014), which people generally mention with packaging and transportation when discussing the environmental impact of food (Macdiarmid et al., 2016). Perhaps people acknowledging the environmental impact of food waste may be due to wasted food being present in households. Consumers can see the amount of food waste thrown away into a bin or biowaste, which might be one explanation for people's perceptions towards food waste.

Nevertheless, misconceptions are common in food-related issues. These misconceptions are connected to the climatic impact of food, environmental importance of packaging, a

reduction in the consumption of meat, transportation and organic food. To date, several studies show that people are unfamiliar with the climatic effects of food production (see e.g. Truelove & Parks, 2012). Previous studies indicate that consumers underestimate food production having warming impacts on the climate (Macdiarmid et al., 2016; Vanhonacker et al., 2013). The study by Vanhonacker et al. (2013) about Flemish consumer attitudes towards more sustainable food choices argues that the consumers underestimated food production as a greenhouse gas contributor and evaluated industry, transport, energy use, consumption society and waste to be the five biggest anthropogenic sources of carbon dioxide (CO_2). Furthermore, the study by Macdiarmid et al. (2016) about public awareness of the environmental impact of food and reluctance to eat less meat, declares some participants being unfamiliar with the relation between food and the warming of the climate.

It is claimed some actors having precluded the climatic impact of food production becoming public (see e.g. Andersen & Kuhn, 2014), which may have prevented people from gaining knowledge on the subject. Another possible explanation of people being uninformed may be that there is a great amount of contradicting information available from various actors, such as environmental and agricultural organisations (see e.g. Mikkola, 2014).

In addition, when the climatic effects of food, in general, are underestimated, so is the environmental and climatic impact of a reduction in the consumption of meat. People know little of meat production (Hartmann & Siegrist, 2017) and minority beliefs reducing meat consumption is a considerable action regarding the environment (Lea & Worsley, 2008; Vanhonacker et al., 2013). Even though agriculture creates about 20% of global greenhouse gas emissions (McMichael et al., 2007) and animal-based products, especially beef and cheese, have generally a more substantial warming impact on the climate than plant-based products such as peas and soybeans (Clune et al., 2017), people underestimate the climatic impact of reducing meat consumption (Truelove & Parks, 2012) and are unaware of their meat consumption having a warming impact on the climate (Macdiarmid et al., 2016). Eating meat is generally a part of everyday life, culture and identity (Bohm et al., 2015; Rothgerber, 2013), which may be one explanation for people not questioning

the climatic and environmental impact of meat. For example, the more one eats meat, the lower is the estimate of meat's environmental impact (Tobler et al, 2011).

People, on the other hand, overestimate the environmental importance of reducing packaging and avoiding redundant packaging (Lea & Worsley, 2008; Tobler et al., 2011), even though the manufacturing of the package of the whole environmental impact of for example cheese, broiler and cucumber is from 0.5 to 2% (Katajajuuri, 2008). According to the study by Macdiarmid et al. (2016), the participants generally discussed food packaging causing environmental impacts in the food supply chain. One possible explanation for people overestimating the ecological impact of packaging may result from packaging waste being visible in households. Since the issue is visible, it may be easy for people to make consumption choices such as minimising redundant packaging and increase the sorting of waste. These actions may feel easy and concrete ecological actions (Katajajuuri, 2008), which may lead to overestimating the environmental impact of packaging.

In addition to overestimating the environmental effect of packaging, the effect of transportation is overestimated. People believe that transportation of food products creates most of the environmental impacts of food (Macdiarmid et al., 2016), even though it generally is only 5% of products' climatic impact (Riipi & Kurppa, 2013). The majority of people consider avoiding imported products and purchasing local products as a considerable action concerning the environment (Lea & Worsley, 2008). One third of the participants of the study by Vanhonacker et al. (2013), who studied consumer attitudes towards more environmentally friendly food choices, considered purchasing local food as an environmentally friendly behaviour.

Besides local food, some people overestimate the environmental sustainability of organic food products and regard organic products as an ecological choice (Lea & Worsley, 2008; Van Loo et al., 2010). However, organic food is not a synonym for ecological food (Lähde, 2019) as the environmentally negative impact of an organic product can be bigger than the impact of an industrially manufactured product. For example, the emissions of

ammonia and greenhouse gases but also the land area required to produce 1 kg live weight of broiler are greater in organic broiler production than in conventional production (Bokkers & de Boer, 2009).

There are also previous studies on nutritional knowledge. However, these studies on peoples' awareness of linkages between food's health effects are scarce, old and/or geographically distant from the location of this study, which questions how much conclusions can be drawn from these. Nevertheless, a study by Lea and Worsley (2002), who have studied peoples' awareness of food-related health issues, declares that only approximately 8% of the females and males of the study agreed on meat causing cancer and roughly 13% of the females and 10% of males recognised meat causing heart disease. On the other hand, the study by Macdiarmid et al. (2016) elucidates people associating excessive consumption of red meat and a possible decrease in the state of health. Even though these studies are contradictory with each other, it is generally possible that meat as a central and nutritionally valuable ingredient and the main source of protein in many cultures (Bohm et al., 2015) influences the ignorance or even denial of the health hazards of meat.

In addition to studies on health and meat consumption, there are studies concerning health and vegetarian diet. The study on attitudes and beliefs of vegetarians and omnivores by Mullee et al. (2017) declares a vegetarian diet being considered often a healthy diet by 74.2% of omnivorous respondents. Furthermore, the study on factors associated with beliefs of health benefits of a vegetarian diet by Lea and Worsley (2003b) claims that 64% of omnivorous respondents acknowledged a vegetarian diet decreasing saturated fat intake. However, it is possible that awareness of health risks concerning excessive meat consumption and health benefits of a plant-based diet has increased during past years, particularly in Finland where the consumption of plant-based products has increased as mentioned earlier (see e.g. Pitkänen, 2018).

There is some food-related literature situating in a Finnish school environment. For example, a study by Kaljonen et al. (2018), which was an experimental study on

sustainability transition regarding food, took place in two comprehensive schools and one school that combines lower and upper secondary. The study declares that a vegetarian diet creates resistance, which differs between genders and living areas. Researchers claim that meat is linked to gender identity and our food culture, as boys defended meat and criticized vegetarian food when comparing different sources of protein and their GHG emissions. Furthermore, in the rural schools, around 60% to 70% of boys chose another meal instead of a vegetarian meal, whereas in the urban school only a third of boys acted alike. A similar pattern was observed among girls in the rural and urban school. It is possible that people live in their own bubbles, which may influence food literacy as well.

As there is a lack of literature on food literacy situated in the upper secondary in Finland, this thesis aims to reveal the extend of food literacy among upper secondary school students to fill in the missing gap but also to find out to what extent does the knowledge of food literacy differ based on gender, study year and living area.

2.3 Food literacy in Finnish schools

Food is a trending topic in Finland, as previously argued, and environmental sustainability has been planted in different parts of society, such as in the Finnish curriculum. The Finnish curriculum (Opetushallitus 2015) claims that upper secondary school education strengthens student's knowledge of human influence on the state of the environment and increases student's understanding of sustainable consumption of natural resources, factors influencing climate change, and protection and deterioration of biodiversity, to which food production and consumption also affect (see Appendix 1). The Finnish curriculum includes one thematic entity called *Sustainable lifestyle and global responsibility*. This entity teaches students to analyse links between sustainable lifestyle, production and consumption habits and understand the importance of one's actions, which is linked to food literacy as food choices have a clear connection to a sustainable lifestyle.

In upper secondary school, some subjects touch on food literacy, such as health education and biology. For example, two key issues in the first course of health education are diet promoting health benefits and common diseases, to which also food choices influence. Biology as a subject emphasises environmental issues and guides students to compare, analyse and estimate the human impact on ecosystems. Moreover, students learn about the causes for environmental problems such as threats towards biodiversity and ecosystems. Moreover, food is emphasised in optional courses of biology, which teaches students about breeding plants and animals in food production (Opetushallitus, 2015).

In addition to biology and health education, geography and other subjects touch on food literacy. Geography examines phenomena and interaction between nature, people and society. In the course of optional studies, sustainable consumption of natural resources is taught to students with agriculture, forestry and fishery. Food literacy appears also in other school subjects, such as in a course of Finnish, Swedish and foreign languages, which have courses called for example *Sustainable Lifestyle*, *Our Common Earth* and *Nature and Science* (Opetushallitus, 2015).

Nevertheless, food literacy may be ignored as it competes with other subjects (Nanayakkara et al., 2018) and because it is only partly included in compulsory courses. Though the thematic entity of sustainable lifestyle and global responsibility appears in Finnish curriculum, I argue that there is a possibility that it is only superimposed on the Finnish curriculum and with possible lack of resources, such as lack of time, the thematic entity is easily disregarded.

By embedding food literacy, especially critical environmental knowledge, into compulsory core subjects or creating a new core subject of food literacy, the status of food literacy could be elevated (Nanayakkara et al., 2018). Currently, students who complete more than the compulsory courses in biology and geography acquire more information for example about food production. Therefore, a new compulsory course, which includes issues from the thematic entity, could support subjects of biology and geography without interfering them. The course could be a holistic entity conjoining critical knowledge of food literacy but also functional knowledge, which emphasises, for

example, food-related skills. Functional knowledge is needed in making of ecological and palatable food, because in some cases lack of food preparation skills may function as a barrier to follow a more ecological and plant-based diet (Jokinen et al., 2015). There are possible benefits of creating a compulsory course. For example, this would ensure students to acquire information about food-related issues and ensure the teaching of the thematic entity. However, creating a new compulsory subject or a course would require additional resources such as time and funding (Nanayakkara et al., 2018).

3. Materials and methods

In Finland, there are several general ethical principles guiding researchers from separate disciplines. According to these principles, a researcher needs to respect study subject's human value and to conduct the research in a way that no risks nor harm are caused to the participants, to the communities or other objects of the study (Tutkimuseettinen neuvottelukunta, 2019). These general ethical principles were acknowledged when the study was designed and conducted. For example, the cover letter for the students emphasised responding being voluntary and that the responding to the questionnaire could be interrupted at any time. Moreover, it was emphasised and confirmed that the responses would be dealt confidentially and by ensuring anonymity. Furthermore, no risk or harm was considered to be caused by the theme or the methods of this study.

Moreover, there are ethical principles regarding studying of underaged persons. Firstly, information about the research needs to be given to the minors in an understandable manner (Tutkimuseettinen neuvottelukunta, 2019), which was ensured by informing the participants about the aim and the meaning of the questionnaire and study, and by pretesting the questionnaire in Tikkurila Upper Secondary School. Secondly, according to the ethical principles, if the minor has turned 15 years, the permission of the minor is participating in the study is sufficient (Tutkimuseettinen neuvottelukunta, 2019). This information was acknowledged when the target group was contemplated. As the upper secondary school students are over 15 years old, no ethical preliminary assessment was needed (Tutkimuseettinen neuvottelukunta, 2019). Nevertheless, permissions to conduct research were applied from different cities such as Helsinki, Joensuu, Oulu, as needed.

3.1 Measurements

Since upper secondary school students are an extensive group, the study is performed as a quantitative sample survey, which is not random or systematic sampling. A sample survey can be conducted via the Internet, where data is acquired easily, without costs and in real time. The benefit of the quantitative approach is that it helps to form an overall view (Heikkilä, 2014) of what is the extent of current food literacy and how does it differ

between groups, such as gender, school year and living area. Moreover, previous studies have used a questionnaire to study knowledge and awareness of food-related health and environmental knowledge (see e.g. Lea & Worsley, 2008; Pohjolainen et al., 2016).

3.1.1 The distribution of the questionnaire

The collecting of the data was conducted by using an online Typeform -questionnaire and the questionnaire was distributed to teachers in various ways beginning January 17. 2019, and ending March 7. 2019. Firstly, the questionnaire was shared in the Environmental Educators Newsletter by WWF. Secondly, different organisations were reached via Facebook, such as Union of Biology and Geography Teachers (Biologian ja maantieteen opettajien liitto BMOL ry) and the Union of Finnish Nature- and Environmental Schools (LYKE-verkosto). Thirdly, an advertisement was shared in WWF Teachers room (WWF Opehuone) and Climate educators (Ilmastokasvattajat) – Facebook groups. Later these posts were commented so the advertisement would pop up in the feed. Lastly, an email about the questionnaire with a cover letter was sent to Finnish upper secondary schools, whose email was to be found on the Internet. Because of the way the questionnaire was sent, the rate of answer per cent N was left unknown.

The questionnaire was accompanied by a cover letter for teachers and one for students. The letter for teachers situated in WWF's web page (WWF, 2019) and the letter for students situated in the beginning of the questionnaire (see Appendix 3). Letters explained the meaning and importance of the research and contained instructions. They also emphasized anonymity and voluntariness of answering and confidentiality of handling the data. Teachers were advised not to introduce the food-related health or environmental issues to the students beforehand to ensure that students are at the same line when filling in the online questionnaire.

Teachers were motivated to conduct the questionnaire during a lesson to the students in two ways. The first motivator was a sponsored draw of WWF's shirt for teachers and the second was a small presentation of the environmental and health effects of food, that

could be viewed with the students after filling in the questionnaire. However, only eight teachers participated in the draw, so the effectiveness of the draw as a motivator can be questioned.

It is noteworthy that in this thesis the teachers' motivation in conducting the questionnaire to students influences on the student participation, which effects on the sample and the nonresponse and that the sample is not random. The population of the teachers may be skewed, and teachers interested in food-related environmental or dietary health issues may have been more prone to conduct the questionnaire to the students, who also may be more aware of the dietary health and environmental issues because of the teacher's influence.

3.1.2 The questionnaire

Socio-demographics included in this study included three variables. These variables were gender, school year and living area, which were used to reveal how does food literacy differ between these factors. In addition to sociodemographic variables, some background information was needed to assess the importance of school education in teaching food literacy. To acquire this information, it was asked from where the students have acquired most of the information about foods' environmental and health impacts. The response options for this question were school, home, media, social media, friends, advertisement and the Internet. A response option "other" was included but no analyses on this was conducted due to the latter decision of analysing the data from a quantitative approach.

Food literacy: environmental knowledge

The questionnaire consisted of two main sections (see Appendix 3), of which the first part emphasized environmental knowledge of food literacy (see Table 1). To create a questionnaire, a search on environmental knowledge and food literacy was conducted (Clune et al., 2017; FAO, 2016; Katajajuuri, 2008; Mottet et al., 2017; Pohjolainen et al., 2016; Riipi & Kurppa, 2013; Rönkkö, 2013; Steinfeld et al., 2006). Nonetheless, no

questionnaire about food-related environmental knowledge, which could have been utilized in this thesis was found.

The first part of the questionnaire focused on environmental knowledge and consisted of three subtopics. These subtopics were general environmental knowledge, food production environmental knowledge and GHG knowledge. General environmental knowledge contained two items and focused on students' consideration of food regarding other environmental stressors and environmental importance of food-related choices. In the first section, to measure this awareness, the students were to choose three biggest GHG sources from six response options: traffic, travelling, dwelling, food, household goods and clothing and hobbies.

Thereafter, the focus of general environmental knowledge section was shifted from GHG sources to environmental impacts, and the students were to assess how environmentally important different changes in diet are regarding the environment. The items in this section were reducing food waste, reducing packaging material, avoiding imported foods, favouring vegetables instead of meat and favouring organic food (see Table 1 and Appendix 3). The environmental importance of the various changes in diet was measured by using a 5-point Likert scale.

The following section focused on environmental food production knowledge, that contained eight items related for example to the concepts of biodiversity, water use, eutrophication and deforestation (see Table 1 and Appendix 3). To measure this knowledge, various statements were formed to which students were to either agree or disagree, to which "I don't know" option was included to reduce random guessing.

The last two items of this section were slightly different from the preceding six statements, as the number of response options varied, or the form of question was dissimilar which influenced to the response options (see Table 1 and Appendix 3). The first item of these two emphasised the issue of land area needed to produce food. In the questionnaire, it was asked: "Which's production required more land area: to produce

plants or meat?". This item had four response options: to produce plants, to produce meat, they require the same amount of land area, and "I don't know". The second item requested students to examine, which produces most of the environmental impact of food: primary production or transportation and packaging, with three response options. The response options were packaging and transportation, primary production and "I don't know".

In the GHG knowledge section, that contained eight response options, the students were to choose two products from response options pea, cheese, pork, soy, beef, broiler and salmon with the biggest and the smallest GHG emissions (see Table 1 and Appendix 1), which are produced during the manufacture of the product and as before, "I don't know" -response option was included among the response options. These emissions of various food products can be presented for example in the form of kg CO_2eq/kg of product, in which different greenhouse gases are converted in the form of CO_2 (Clune et al., 2017).

Food literacy: health knowledge

The second part of the questionnaire concentrated on food-related health knowledge. In order to create a questionnaire, a search of health knowledge and food literacy was conducted. The questionnaire was built by using literature and some already made questionnaires surrounding the topic (Elintarviketurvallisuusvirasto, 2016; Elintarviketurvallisuusvirasto, 2017; Terveyden ja hyvinvoinnin laitos, 2019a; Valtion ravitsemusneuvottelukunta, 2014; Pohjolainen et al., 2016). Even so, no questionnaire about food-related health knowledge that could have been directly applied was found.

Food-related health knowledge consisted of two subtopics: dietary health knowledge and protein knowledge. The first subtopic, which contained eight items, focused on students' awareness of how diet choices may influence health and increase risks regarding certain diseases. This awareness was measured by eight distinct statements to which students were to either agree or disagree. An "I don't know" option was included to reduce random guessing (see Table 1 and Appendix 3).

The health section was supported by a subtopic on protein knowledge, that included six items: 100g of dried fava bean mince, 100g of dried soybeans, 100g of uncooked broiler breast, 100g of cream for cooking, 100g of curd cheese and 100g of an apple. The section was included in the questionnaire as people regard meat as a central protein source and diminish plant-based protein sources (Bohm et al., 2015; Kaljonen et al., 2018). Moreover, the section was included to study if people generally consider other animal-based products besides meat to contain more protein than plant-based products. To measure protein knowledge, students were to estimate if the source of protein is abundant (>20 g/100 g) in protein or does it contain some or moderately protein (<20 g/100 g). Moreover, "I don't know" response option was included (see Table 1 and Appendix 2 and 3).

The questionnaire was aimed to be appealing, neutral, clearly structured, logically arranged, easy to use and unambiguous (Heikkilä, 2014) and it was pretested by 57 students in Tikkurila Upper Secondary School (Tikkurilan lukio). While pretesting the questionnaire, the students gave feedback on the questionnaire and it was noticed that vegetarianism can be considered in various ways. For instance, the issue of chicken being part of a vegetarian diet appeared. Complex terms such as primary production and vegetarian food were defined and the difference between traffic and travelling was explained.

Excluded sections

The questionnaire included topics that were later excluded from the analysis such as topics about opinion, self-efficacy, respondents' diet, relation to and motivation of meat consumption and the number of vegetarians in the inner circle and respondent's birth year. The questions regarding opinions asked students' views on environmentally friendly food. Furthermore, they requested, what should be done to increase the consumption of ecological and healthy food and whose responsibility is it. The questions were open formed questions, which were included to reveal possible new ways of thinking ecological and healthy food.

Self-efficacy was emphasised by asking students' belief in their possibilities on influencing the state of environment and health with their food choices and measuring it using a 5-point Likert scale. Self-efficacy was one of the interests in this thesis as a similar question appeared in the study by Pohjolainen et al. (2016), which inspired creating the question. It would have been interesting to study students' believes in their abilities to influence to health and the environment as well as to conduct a correlation analysis between self-efficacy and different types of knowledge.

Moreover, student's diet, relation to meat consumption and their motivations behind the meat consumption were asked in the questionnaire, as these were key interests in the thesis. With the data acquired by the questionnaire concerning these issues, it would have been, for example, possible to study are there differences in the motivation of those people who try to reduce their meat consumption in relation to those who do not consider reducing their meat consumption. Moreover, with the data, it would have been possible to create correlation analyses between these factors and health and environmental knowledge.

Furthermore, as an inner circle, and other people in general, may influence one's food consumption, a question concerning the number of vegetarians in the inner circle of the respondent was formed. This question was formed since there was an interest to study the correlation between the number of vegetarians in the inner circle, motives to reduce meat consumption and different types of knowledge.

However, these issues were excluded from the analysis as the questionnaire was narrowed down, during the data analysis, to create a more comprehensible research entity focusing solely on critical knowledge of food literacy. Also, birth year was excluded from the analysis as the school year was used as a grouping variable in addition to gender and the living area.

Table 1 Measured concepts and questions measuring the concepts.

Measured concepts	Questions measuring
Sociodemographic variables	
Sources of food literacy	
	From where have you got most of the information about foods' environmental and health effects? Choose one to three among options.
Environmental knowledge	
General environmental knowledge	
	Choose three biggest greenhouse gas of an average Finnish consumer.
	How environmentally important are following changes in diet in relation to the environment?
Environmental food production knowledge	
	Food production causes notable environmental problems
	Food production effects on decreasing of biodiversity
	Most of freshwater used by human is used for food production.
	Plant production causes substantially more eutrophication than meat production.
	Meat production increases deforestation.
	Most of soy is used for animal feed.
	Choose, which one requires more land area: plant production or meat production.
	Which of the two following options produces most of the environmental impact of food: packaging and transportation or primary production?
Greenhouse gas knowledge	
	Choose two options of following that have the biggest greenhouse gas emissions.
	Choose two options of following that have the smallest greenhouse gas emissions.
Health knowledge	
Dietary health knowledge	
	Meat is a necessary part of a healthy diet.
	People who consume red meat and meat products abundantly have greater occurrence of colorectal cancer
	Risk for type II diabetes increases eating red meat and meat products abundantly
	Risk for cardiovascular diseases decreases by eating less red meat and meat products.
	Meat is especially abundant in highly absorbable iron.
	Pulses, such as beans and lentils, are abundant in protein.
	Vegetarian diet has a recuperative effect on fat levels of blood.
	A diversely composed vegetarian diet is healthy.
Protein content knowledge	
	Do the following contain a large quantity (>20g/100g) or a little/moderately (>20g/100g) of protein?

3.2 Statistical analysis

In the analysis, IBM SPSS Statistics 24 software was used. Descriptive statistics were calculated using frequency analysis, which is the simplest way to describe frequencies that is quantities of the data (Nummenmaa, 2004) for different sociodemographic characteristics and food literacy sources. In practice, frequency analysis calculates how many different observations the data includes. Calculating frequencies is one of the most important data description method (Nummenmaa, 2004). Frequency analysis was conducted for different sociodemographic variables such as gender, study year and living area. Moreover, these variables were used in further analyses as grouping variables to reveal to what extent does the knowledge of environmental and health issues differ based on these characteristics.

3.2.1 Food literacy: environmental knowledge

To study the RQ1. To what extent are upper secondary students aware of the environmental impacts of food, descriptive statistics were calculated using frequency analysis from different sections of environmental awareness. Before using frequency analysis for the first section of environmental knowledge, the response options of general environmental knowledge were coded between one to seven that is each response option had their own number as well as the blank responses. However, no further analyses were conducted of the section of general environmental knowledge, as the section was created to provide background information.

In the section of environmental food production knowledge, that consisted of eight distinct items (see Table 1), to calculate descriptive statistics using frequency analysis, the correct answers were coded as ones, the incorrect ones as two and “I don’t know” were coded as three. However, there were three statements and questions, which required more preparations before frequency analysis. The statement concerning the eutrophication of environmental food production knowledge was false and thus recoded to be in line with the other statements. In addition, the statement: “Which one’s

production requires more land area?", included four response options: "plant-based food", "meat-based food", "they require equally land area" and "I don't know". These response options were coded into three categories. The correct option "meat-based food" was coded as one, incorrect options "plant-based food" and "they require equally" were coded as two, whereas "I don't know" was coded as three. Furthermore, the last item of the section: "Which of the two following options produces most of the environmental impact of food" had response options "packaging and transportation", "primary production" and "I don't know". The correct response "primary production" was coded as one, the incorrect response of "packaging and transportation" as two and "I don't know" as three. Coding and recoding of these items were necessary to maintain conformity between the statements.

After coding the answers and conducting frequency analysis, reliability was calculated to reveal if it was justified to create of SUM variable by using Cronbach's alpha which reveals do the variables reliably measure the same issue (Metsämuuronen, 2000a). Cronbach's alpha, used in human sciences, is employed to measure internal consistency, in other words, it is a measure of consistency and thus as a measure of reliability and repeatability. Calculating reliability is based on splitting half the variables concerned. The high correlation between these half split variables indicates the unity of the variables. Therefore, Cronbach's alpha is based on the idea that the mean of the correlation is calculated from these various combinations of these half split variables (Metsämuuronen, 2000a).

High reliability of Cronbach's alpha informs the different sections of the measure assessing the same issue, it represents individuals answering the same way with several different times of measurement and it indicates that the measure reliably divides individuals measured from each other (Metsämuuronen, 2000b). According to Metsämuuronen (2000b) the reliability of a low alpha (0.60), which is, in general, the lowest acceptable value, is reasonable as far as the size of the sample size is extensive. In this study, it was reasonable to create a SUM variable as the Cronbach's alpha of environmental food production knowledge section was 0.638 (see Table 2) and deleting variables would have decreased the value.

To operationalise a variable to measure the extent of environmental food production knowledge, a SUM variable was created. A SUM variable is used to summarize information from different variables into one variable that is there is no need to analyse the statements separately but as one. It is essential that the variables summed together measure the same feature, in this case, knowledge, which was examined using Cronbach's alpha (Nummenmaa, 2004). I used SUM variable to summarize eight environmental food production knowledge variables into one variable, which for example simplifies comparing environmental food production knowledge between study year, gender and living area.

However, as there were only three response options or the response options were coded into three groups in each eight distinct statements and questions (see Table 1), before summing the variables together, correct answers were coded as one and incorrect or neutral that is "I don't know" -responses as zero, like in the research of Dijkstra and Goedhart (2012). As a result, the minimum score of the environmental food production knowledge SUM variable is zero as the maximum sum is eight, which is same as the number of environmental food production knowledge items. The higher the extent of knowledge, the higher is the sum.

From the SUM variable, I have calculated mean and standard deviation to describe the average level of environmental food production knowledge (see Table 2). Mean describes what is approximately the size of measured values, it also maps the location of statistical distribution. On the other hand, standard deviation informs the average distance of the observations from the mean, which is why it is necessary to report standard deviation with mean, and around which values are the observations divided. Standard deviation can be calculated if the variable is measured at least in an interval scale (Nummenmaa, 2004).

Similar calculations were conducted for GHG knowledge in the environmental knowledge section (see Table 1). In this section, the students were asked to choose two food products, from eight different response options, whose production and consumption

had the biggest and the smallest emissions. As a result, the options that were not chosen by the respondents were left blank in the SPSS data. This section was coded the similar way as the general environmental knowledge; however, the blank responses were coded as zero. Afterwards, frequency analysis was used a similar way as earlier.

To operationalise a variable to measure the extent of GHG knowledge, a SUM variable was created from the questions from the GHG knowledge section, although no reliability could be calculated using Cronbach's alpha as there were too few cases due to the number of blank responses in the data. Correct responses, beef and cheese, whose life cycle has the biggest greenhouse gas emissions and soy and pea, whose life cycle has the to the smallest greenhouse gas emissions (see Appendix 1), were coded as one and other options: pork, broiler, salmon and "I don't know" were coded as zero (Dijkstra & Goedhart, 2012). As the amount of correct answers in this section is four, the maximum GHG knowledge measured from a SUM variable is four. Similarly, to environmental food production knowledge, mean and standard deviation were calculated from the GHG knowledge SUM variable (see Table 2).

To study the RQ3. To what extent does the knowledge of food-related issues differ based on gender, study year and living area, various calculations were conducted from the environmental knowledge section. Differences were calculated from subtopics environmental food production knowledge and GHG knowledge. To reveal differences, an Independent Samples t Test was used as well as a One-way ANOVA, depending on the number of groups examined.

T-tests are parametric tests, which require the existence of an assumption about normal distribution, at least measuring by an interval scale and at least 20 observations from each group studied. Moreover, they are the simplest statistical tests used to examine the location of the distribution by using standard error of the mean. From t-distribution with certain degrees of freedom, it can be concluded how likely it is to acquire a value of test statistic by chance. It is rare to acquire a big absolute value; however small absolute

values are common that is, it is probable to acquire small values by chance (Nummenmaa, 2004).

One form of t Tests is an Independent Samples t Test. With the Independent Samples t Test, it is possible to compare the means of two independent groups (Nummenmaa, 2004). I used the Independent Samples t Test to compare the means of different genders, male and female, to each other. As previously mentioned, to use a t-test, the distribution needs to be normally distributed. A SUM variable about environmental food production knowledge was normally distributed according to skewness (.012) and kurtosis (-.771) and a histogram.

When conducting a calculation with the Independent Samples t Test, SPSS calculates Levene's test for equality of variances. This test reveals if the variances are equal ($F < .01$, $p > 0.05$), which leads to reading the results from the row *Equal variances assumed* in SPSS. If the variances are unequal ($p < .05$), the Independent Samples t Test should not be used. Using T-test requires t-value, degrees of freedom and p-values to be reported (Nummenmaa, 2004).

As the Independent Samples t Test is not suitable for more than two groups, to study RQ3. concerning study year and living area, comparisons were made using a One-way ANOVA. It is similar to the Independent Samples t Test, however, it can be used for situations where there are more than two groups. Thus, the One-way ANOVA is a parametric test, which requires the existence of assumption about normal distribution, at least measured by an interval scale, homogeneity of variances and approximately 20 to 30 observations from each group studied (Nummenmaa, 2004).

A variance analysis such as the One-way ANOVA reveals whether the mean of the groups studied differ significantly from each other. The One-way ANOVA also calculates Fisher's F ratio, with which can be observed if the variances are equal. The most important for reporting and interpretation are degrees of freedom, F ratio and p-values. However, F ratio tells does means of the groups differ (Nummenmaa, 2004).

As the F ratio tells if the means of the groups differ but do not tell which groups differ, Post Hoc Tests were used to reveal which groups differ from each other. The simplest Post-hoc test is Fisher's Least Squared Differences (LSD) test. Post Hoc Tests, such as the LSD test, reports the *p* values, which reveals which groups significantly differ from each other (Nummenmaa, 2004). In this study, the LSD test was used to reveal which study years and living areas differ from each other.

Similar parametric tests were conducted to GHG knowledge SUM variable, which was normally distributed according to skewness (-.593) and kurtosis (.474) and a histogram. Since GHG knowledge was normally distributed, parametric tests were used to compare means. Comparisons between genders were made using the Independent Samples t Test and whereas comparisons between living areas and study years were made using the One-way ANOVA and the Post-hoc LSD test.

3.2.2 Food literacy: health knowledge

Health knowledge section includes two subthemes: dietary health knowledge and protein knowledge. Firstly, to study RQ2. To what extent are upper secondary students aware of the health impacts of food, the correct answers from dietary health knowledge section (see Table 1) were coded as one, the incorrect responses were coded as two and "I don't know" were coded as three. After this, descriptive statistics were calculated using frequency analysis.

Reliability was calculated, to reveal if it was suitable to create a SUM variable, by the same way as it was calculated for environmental food production knowledge, using Cronbach's alpha, which was for the eight different statements 0.638. The value of Cronbach's alpha was reasonable as it exceeds the lowest acceptable value of 0.6 (Metsämuuronen, 2000b) and the sample size was extensive, which will be presented in the section concerning the participants.

To operationalise a variable to measure the extent of dietary health knowledge, a SUM variable was created. Using SPSS, the SUM variable was calculated from dietary health knowledge, which consists of eight distinct statements (see Table 1). Before creating the SUM variable, the first statement, concerning the necessity of meat consumption, was reversed to be in line with other seven statements in the creation of the SUM variable. For the SUM variable, right answers to statements were recoded as one, whereas incorrect and neutral answers were recoded as zero. Therefore, the maximum of dietary health knowledge SUM variable is eight as there are eight distinct statements. Moreover, a mean and standard deviation were calculated from the dietary health knowledge SUM variable as previously (see Table 2).

Same analyses, such as frequency analysis, were conducted for protein knowledge (see Table 1), which had six items: dried fava bean mince, dried soybeans, uncooked broiler breast, cooking cream, curd cheese and an apple. Each item had three distinct response options, which were coded from one to three. Thereafter, reliability was calculated using Cronbach's alpha. The value of Cronbach's alpha was 0.815, which is near to high alpha of 0.9 indicating high reliability (Metsämuuronen, 2000b). Noteworthy is that the value of Cronbach's alpha would have decreased if variables would have been deleted.

After calculating the Cronbach's alpha, correct answers were coded as one and incorrect and neutral as zero as previously (Dijkstra & Goedhart, 2012). These were summed together to create a SUM variable of the protein knowledge. As there were six different variables in the section, the maximum level of the protein knowledge was as well six. Moreover, a mean and a standard deviation were calculated from the SUM variable (see Table 2).

Health knowledge SUM variables that is, dietary health knowledge and protein knowledge were normally distributed. Dietary health knowledge SUM variable was normally distributed in terms of skewness (-.843) and kurtosis (.169) and protein knowledge was normally distributed with skewness of -.559 and kurtosis of -.437. Consequently, similar parametric tests, such as the Independent Samples t Test and the One-way ANOVA, were used to identify differences between groups in case of dietary

health knowledge and protein knowledge to study the RQ3. “To what extent does the knowledge of these issues differ based on gender, study year and living area?”

Table 2 Mean values, standard deviations and Cronbach’s alpha reliability values for each knowledge measured. The measured concepts are found in Table 1.

Measured SUM variable	Number of items	Mean (n = 1320)	SD (n = 1320)	Cronbach’s alpha
Environmental knowledge: Environmental food production knowledge	8	4.14	2.042	0.638
Environmental knowledge: GHG knowledge	8	2.40	0.855	
Health knowledge: Dietary health knowledge	8	5.43	1.971	0.638
Health knowledge: Protein knowledge	6	3.45	1.658	0.815

3.3 Data

3.3.1 Participants

1324 persons answered the questionnaire and the n of the final data was 1320 individuals. Four individuals were deleted from the data as the target group consists of upper secondary students and the excluded four individuals were teachers or principals.

35% of the respondents were male and 62% were female. Approximately 3% identified themselves as “other” (see Appendix 4). The distribution by gender quite well represents the distribution of genders in an upper secondary school as in Finland, 58% of upper

secondary school students are female (Tilastokeskus, 2019). Moreover, 1311 students announced their study year. Over half of the respondents were in their first year of upper secondary school whereas approximately a third of students were in second year and less than a tenth was in third year of upper secondary school.

The questionnaire reached respondents from many different localities, mainly from cities. Oulu, Espoo, Helsinki, and Kuopio had more than 100 respondents each. Imatra, Nakkila, Lahti, Joensuu had 40 or more respondents. Other municipalities of residence had less than 40 respondents, which is why no separate identification was needed as it was not in the interests of this study. Almost a third of the students (n = 1320) lived in centres of population or rather small towns. A quarter of respondents lived in the Helsinki Metropolitan Area and a fifth of respondents lived in the countryside. Almost a third lived either in cities of more than 100 000 residents or in cities of 20 000-100 000 residents (see Appendix 4). The size of the sample and that there were students from different places in Finland are advantages of the sample.

4. Results

The results section of this thesis reveals the extent of food literacy of the upper secondary students and significant differences between the groups. Firstly, it is examined, which sources of food literacy the students consider as the main sources. Secondly, the extent and the characteristics of upper secondary students' environmental knowledge, general environmental knowledge, environmental food production knowledge and GHG knowledge, is presented. Thirdly, the extent and the features of food-related health knowledge, dietary health knowledge and protein knowledge, is presented.

4.1 Sources of food literacy

The students were asked to choose three main sources of food-related health and environmental knowledge from eight distinct options. As shown in Table 3, the majority of the students considered school to be the main source of information about food's health and environmental impacts, as 73.6% of the respondents chose school to be an important provider of health information and 59.7% of the respondents considered the school as the main source of environmental information. Moreover, half of the students considered the Internet as one of the main sources of food-related health and environmental information. The results indicate that the third most important source of information about food's health impacts is home, whereas in turn, the third most important source of food-related environmental information is social media.

Table 3 The share (%) of sources of information about food's health and environmental impact (n = 1320)

	School	Internet	Social media	Home	Media	Friends	Advertisement	Other
Health knowledge	73.6	51.3	33	39.6	29.6	6.2	5.2	1.5
Environmental knowledge	59.7	52.2	43.5	21.5	39.2	10.3	7	1.3

4.2 Food literacy: environmental knowledge

4.2.1 General environmental knowledge

To study the RQ1. To what extent are upper secondary school students aware of the environmental impacts of food, the first set of statements aimed to reveal the general environmental knowledge of the upper secondary school students. The students were asked to indicate three biggest GHG sources of an average Finnish consumer. The majority of the respondents reported transportation (87.7%) and food (66.1%) to be the biggest GHG sources of average Finnish consumer. Over half of the students (61.8%) chose travelling and almost as many chose dwelling (59.5%) to have vast GHG emissions. The minority of respondents selected household items and clothing (22.7%) and hobbies (2.1%).

To examine more closely the upper secondary students' views on food's relation to the environment, the students were asked to evaluate the environmental importance of various changes in diet (see Appendix 5). The generality of students (79.7%) considered reducing packaging and almost as many believed reducing food waste (77%) to have a very considerable or quite considerable effect on the environment. Over half of the respondents (63.8%) indicated avoiding imported products and over half (56.2%) of the students reported favouring vegetables as an environmentally considerable change in diet. Less than a half (47%) of the students considered favouring organic products as an ecological consumption choice.

4.2.2 Environmental food production knowledge

To study the RQ1. more in depth, the students were asked to respond to eight statements and questions about the environmental effects of food production (see Table 1 and Appendix 3). Most of the students (75.4%) acknowledged, that food production is connected to environmental problems and almost as many (68.2%) knew, that it affects biodiversity (see Appendix 6). About half of the students (51.4%) indicated that most of the anthropogenic freshwater use goes to food production. Less than half of the students

agreed with statements: “meat production causes eutrophication more than plant production”, “meat production increases deforestation” and “most of the soy is used as animal feed”. Half of the students (52.6%) responded that meat production requires more land area than plant production. Moreover, only a third (34.8%) knew that primary production forms most of the environmental impact of food and half of the students believed (53.5%) most of the environmental impact of food coming from packaging and transportation.

What stands in the analysis is that there the neutral responses are abundant. As the more specific issues were presented, the number of neutral responses increased. As the specificity and difficulty of the questions vary, neutral responses varied between 11.7% to 44%. Nevertheless, the mean of environmental food production knowledge calculated from a SUM variable was 4.14 (see Table 4, p. 36). This indicates that over the half of the eight statements have been answered with the right answer as the minimum score of SUM variable is zero and the maximum score is eight, as previously mentioned in the section concerning statistical analysis. The higher the extent of knowledge, the higher is the score.

4.2.3 GHG knowledge

As food consumption causes a significant proportion of greenhouse gas emissions of an individual (Seppälä et al., 2009), to study RQ1., the issue of GHG was emphasised. Thus, to study the upper secondary students’ knowledge of greenhouse gas emissions of various food products, the respondents were asked to choose products that have the biggest and the smallest quantity of GHG emissions per kg of product. The products in question were beef, pork, cheese, broiler salmon, soy, and pea. Almost every student (87.5%) chose beef and over half (61.4%) selected pork to have the biggest GHG emissions whereas the minority (16.9%) chose cheese to have the biggest quantity of GHG emissions per kg of product. Moreover, most of the students (87%) considered pea, almost half of the students (48.9%) evaluated soy and over a third (38.6%) assessed salmon to have the smallest GHG emissions (see Appendix 7).

4.3 Food literacy: health knowledge

4.3.1 Dietary health knowledge

To study the RQ2. To what extend are upper secondary students aware of the health impacts of food, the students were asked to reply to the statements on diets impact on health. The majority of respondents indicated, that meat is not a necessary part of a diet (72%), a vegetarian diet can be healthy (89.25%) and pulses contain abundantly protein (81.4%) (see Appendix 8). Although the students knew meat containing well absorbing iron (58.9%), they also acknowledged vegetarian diet improving fat levels of blood (68.3%).

What stands out in Figure 4 (see Appendix 8) is that the connection between meat and increased risk for colorectal cancer was not that familiar for the students as around half (49.7%) indicated this connection. They were more familiar with the connection between meat and type II diabetes, as 57% of the students indicated the connection. Moreover, 66.4% of the students acknowledged the connection between meat and cardiovascular diseases.

What is interesting in Figure 4 is that the number of neutral responses varied between 4.4% and 36.8%, which is less than in the environmental food production knowledge. Moreover, the mean of dietary health knowledge calculated from a SUM variable was 5.43. This indicates that over the half of the eight statements were answered correctly (see Table 5, p. 40), as the maximum of dietary health knowledge SUM variable is eight on account of eight distinct statements.

4.3.2 Protein knowledge

The amount of protein varies between food products (see Appendix 2) and to study RQ2. more in depth and to examine student's protein knowledge, the students were asked to evaluate the protein amount of various food products of which fava bean, soy and broiler are abundant in protein (see Appendix 9 and Figure 5). As shown in Figure 5, 65.3% of the students chose fava bean and almost as many (58.6%) selected broiler to be abundant in protein. What stands out in Figure 5 is that only less than half of the students (47%) considered soy to contain plenty of protein. Moreover, over half of the students (57.2%) incorrectly indicated curd cheese to be abundant in protein, even though curd cheese that has protein less than 10g/100g (Terveyden ja hyvinvoinnin laitos, 2019a). The majority of the students correctly considered cream (68.8%) and apple (77.3%) to be mediocre or low in protein. As the mean of protein knowledge calculated from a SUM variable was is 3.45, the students answered correctly in over half of the six distinct cases (see Table 5).

4.4 Food literacy: differences in environmental knowledge

4.4.1 Differences in environmental food production knowledge

Analysis by a One-way ANOVA from a SUM variable, created from eight variables, reveals that there are differences in environmental food production knowledge between some of the groups (see Table 4). Differences were found between study years and living areas; however, no significant differences were found between genders. The students in third year had the highest mean of 5.06 (SD = 2.019, n = 111) in environmental food production knowledge and first-year students' mean of 3.97 (SD = 2.017, n = 741) was the lowest as the fourth-year students' mean was not considered due to the size of the group. It was observed by Post Hoc Tests that the first-year students' environmental food production knowledge differed statistically significantly ($p < 0.05$) from second-year students' (n = 450, $p = .029$) and from third-year students' knowledge ($p = .00$). In addition, third-year students differed from fourth-year students ($p = .031$), even though this group was not suitable for comparisons. These results mean that the third-year students are the most familiar with food production and first-year students are the most unaware of food productions impacts on the environment.

The means differed in different areas (see Table 4). The students living in the Helsinki Metropolitan Area (n = 201) had the highest mean of 4.46 (SD = 2.142). The second highest environmental food production knowledge was among students living in the centre of populations or rather small towns, here on referenced as centres of population, with a mean of 4.39 (SD = 1.989, n = 305). The lowest mean of 3.83 (SD = 2.005) was reported among the students living in cities of more than 100 000 residents (n = 396). Analysis by the One-way ANOVA shows that living area effects environmental knowledge ($F_{4,1315} = 5.619$, $p < .00$).

Knowledge of food production significantly ($p < 0.05$) differed between the students from different living areas. It was observed by Post Hoc Tests that environmental food production knowledge significantly differed between the students living in rural areas and the students living in cities of more than 100 000 residents ($p = .007$). Knowledge of students living in centres of population significantly differed from students from cities of 20 000-100 000 residents ($p = .011$) and students living in cities of more than 100 000 residents ($p = .000$). Students of 20 000-100 000 resident cities also differed significantly from the students in the Helsinki Metropolitan area ($p = .008$). Moreover, differences between the students of 100 000 residents and the Helsinki Metropolitan area were observed ($p = .000$).

4.4.2 Differences in GHG knowledge

Significant differences were observed between groups; however, no statistically significant differences were found between study years (see Table 4). In the case of genders, females' (n = 815) mean GHG knowledge was 2.46 (SD = 0.778) and males' (n = 464) was 2.33 (SD = 0.942). According to the Independent Samples t Test, there was a significant ($p < 0.05$) difference between male and female students' GHG knowledge in upper secondary school ($t(822.003) = -2,531$, $p = .012$). The result indicates that females' GHG knowledge was slightly higher than males' GHG knowledge. Noteworthy is that the maximum of GHG knowledge SUM variable is four because the students were

to choose two products with the biggest and two products with the smallest GHG emissions. Thus, the higher the score of GHG knowledge SUM variable, the more aware are the students of the GHG emissions of distinct products.

GHG knowledge, calculated from the GHG knowledge SUM variable, significantly varied between living areas according to the One-way ANOVA, however, no vast gaps between means were observed (see Table 4). Post Hoc Test revealed that the students from centres of population (n = 305) were the most aware of which food products have the biggest and the smallest greenhouse gas emission (M = 2.52, SD = 0.811), whereas the students from cities of 20 000 – 100 000 residents (n = 237) were most unaware of the issue studied (M = 2.23, SD = 0.915). Post Hoc Test revealed that the students from cities of 20 000 – 100 000 residents significantly differed from cities of more than 100 000 residents (p = .013). Moreover, there was a statistically significant difference between the first group and the students from the Helsinki Metropolitan Area (n = 201, M = 2.46, SD = 0.836, p = .005) and centre of population (n = 305, M = 2.52, SD = 0.811, p = .000).

Table 4 Environmental knowledge SUM variables separated by gender, study year and living area using an Independent Samples t Test and a One-way ANOVA

		Environmental food production knowledge					GHG knowledge				
	n	**Mean (SD)**	***p***	**t**	**df**	**F**	**Mean (SD)**	***p***	**t**	**df**	**F**
Total	1320	4.14 (2.042)					2.40 (0.855)				
Gender	1279		0.18	-1.358	905.77			0.012	-2.531	822.003	
Males	464	4.05 (2.121)					2.33 (0.942)				
Females	815	4.22 (1.970)					2.46 (0.854)				
School year	1311	4.15 (2.038)	0.00		3	10.056	2.41 (0.854)	0.724		3	0.441
First year	741	3.97 (2.017)					2.40 (0.854)				
Second year	450	4.23 (2.011)					2.42 (0.844)				
Third year	111	5.06 (2.019)					2.42 (0.848)				
Fourth year	9	3.55 (2.297)					2.11 (1.364)				
Living area	1320	4.14 (2.041)	0.00		4	5.619	2.40 (0.855)	0.002		4	4.224
Rural area	181	4.33 (2.044)					2.38 (0.865)				
Centre of population	305	4.39 (1.989)					2.52 (0.811)				
City of 20 000 – 100 000 residents	237	3.94 (2.001)					2.23 (0.915)				
City of 100 000< residents	396	3.83 (2.005)					2.40 (0.841)				
Helsinki Metropolitan Area	201	4.46 (2.142)					2.46 (0.836)				

n- number of participants, SD-standard deviation, df-degrees of freedom.

4.5 Food literacy: differences in health knowledge

4.5.1 Differences in dietary health knowledge

As stated earlier, the students were more familiar with dietary health than with food production, however statistically significant ($p < 0.05$) differences were found in dietary health knowledge between genders, study years and living areas (see Table 5). Means calculated from a dietary health knowledge SUM variable, which has been calculated for eight various statements, differed between genders according to the Independent Samples t Test and interestingly, the gap between genders' mean dietary health knowledge was quite notable. Males' mean dietary health knowledge was 4.88 (SD = 2.122, n = 464) whereas females' mean was 5.82 (SD = 1.727, n = 815). This difference was statistically significant (t(812.565) = -8.105, p = .000, 2-tailed) which indicates that women's awareness of health effects of diet is higher than men's awareness of the issue.

Mean dietary health knowledge differed between genders but also varied between study years (see Table 5) according to the One-way ANOVA. First-year students had the lowest mean of 5.34 (SD = 1.967, n = 741), second-year students' mean dietary health knowledge was 5.54 (SD = 1.926, n = 450) and third-year students mean, which was the highest, was 5.83 (SD = 1.967, n = 111). The fourth-year students' mean, even though not comparable due to the size of the group, was 5.44 (SD = 2.007, n = 9). Comparing these groups by Post Hoc Test revealed significant differences between first year and third-year students (p = .014). These results indicate that the awareness of diet's possible impacts on health increases from first year to third year.

Statistically significant differences were found, by Post Hoc Tests, between living areas (F(4) = 6.666, p = .000). The students living in the Helsinki Metropolitan Area had the highest dietary health knowledge with mean of 5.77 (SD = 1.778, n = 201) (see Table 5). The students from the Helsinki Metropolitan Area differed from the students from cities of 20 000 – 100 000 residents (M = 5.00, SD = 2.086, p = .000, n = 237) and cities of more than 100 000 residents (M = 5.27, SD = 2.097, p = .003, n = 396).

The students living in cities of 20 000 – 100 000 residents, that significantly differed from the students from the Helsinki Metropolitan Area, had the lowest mean of 5.00. These students significantly differed also from the students from rural areas (M = 5.49, SD = 1.905, p = .012, n = 181) and the students from population centres (M = 5.71, SD = 1.790, p = .000, n = 305). The dietary health knowledge of the latter group was also significantly dissimilar with the students from cities of more than 100 000 residents (p = .003). These results indicate that the students from the Helsinki Metropolitan Area were the most aware of diet's possible health impacts whereas the students from cities of 20 000 – 100 000 residents were the most unaware of diet's health impacts.

4.5.2 Differences in protein knowledge

In addition to food production, GHG and dietary health knowledge, mean protein knowledge varied significantly between study years and living areas (see Table 5). According to the One-way ANOVA, study year affected protein knowledge ($F_{3,1307}$ = 7.301, p < .001). Mean protein knowledge increased from first year to third year, from 3.33 (SD = 1.710, n = 741) to 4.05 (SD = 1.354, n = 111). It was observed by Post Hoc Test that the first-year students' protein knowledge differed from second year (p = .021, n = 450) and third-year students' (p = .000) knowledge and a significant difference was observed between second year and third-year students (p = .004). Moreover, analysis included the smallest group of fourth-year students, who's mean differed from third-year students (p = .040). These results indicate that the students' knowledge of how much protein different food products contain increases with the study year as the first-year students were the most unaware of the protein of various products whereas the third-year students were the most aware of the amount of protein.

The One-way ANOVA revealed that living area influenced the students' protein knowledge ($F_{4,1315}$ = 2.464, p = .043), which varied from 3.27 to 3.67 (see Table 5). The students from cities of 20 000 – 100 000 residents (SD = 1.772, n = 237) had the lowest protein knowledge which means that these students were the most unaware of the protein of various products whereas the students from centres of population (SD = 1.603, n = 305) were the most aware of the amount of protein.

Moreover, significant differences were calculated by Post Hoc Test between the students from centres of a population (n = 305), who differed from the students living in cities of 20 000 – 100 000 residents (p = .005, n = 237) and the students from cities of more than 100 000 residents (p = .018, n = 396).

Table 5 Health knowledge SUM variables separated by gender, study year and living area using an Independent Samples t Test and a One-way ANOVA

		Dietary health knowledge					Protein knowledge				
	n	**Mean (SD)**	***p***	**t**	**df**	**F**	**Mean (SD)**	***p***	**t**	**df**	**F**
Total	1320	5.43 (1.971)					3.45 (1.658)				
Gender	1279		0.000	-8.105	812.562			0.785	-.273	1277	
Males	464	4.88 (2.122)					3.45 (1.629)				
Females	815	5.82 (1.727)					3.48 (1.662)				
School year	1311	5.45 (1.957)	0.057		3	2.515	3.47 (1.651)	0.000		3	7.301
First year	741	5.34 (1.967)					3.33 (1.710)				
Second year	450	5.54 (1.926)					3.56 (1.572)				
Third year	111	5.83 (1.967)					4.05 (1.354)				
Fourth year	9	5.44 (2.007)					2.89 (2.147)				
Living area	1320	5.43 (1.971)	0.000		4	6.666	3.45 (1.658)	0.043		4	2.464
Rural area	181	5.49 (1.905)					3.55 (1.710)				
Centre of population	305	5.71 (1.790)					3.67 (1.603)				
City of 20 000 – 100 000 residents	237	5.00 (2.086)					3.27 (1.772)				
City of 100 000< residents	396	5.27 (2.097)					3.37 (1.607)				
Helsinki Metropolitan Area	201	5.77 (1.778)					3.41 (1.629)				

n- number of participants, SD-standard deviation, df-degrees of freedom.

5. Discussion

In the case of food literacy, critical health and environmental knowledge, the school appears to possess the most notable position. However, sources of food literacy vary somewhat between environmental and health knowledge. The students' food literacy regarding environmental knowledge is supported mostly by schools, the Internet and social media, whereas in turn food literacy concerning health knowledge is supported mostly by schools, the Internet and home. The relevance of schools and the Internet may be reasonably clear, however, there are some possible explanations for the importance of social media concerning environmental information. Young people spend time online on several platforms (Hausmann et al., 2017) where different actors can influence adolescents and their awareness of foods environmental impact.

Another interesting finding is that the students chose health information to be taught by schools more often than environmental information. One explanation may be that the first course of health education, where food's relation to diseases and a healthy diet are taught, is obligatory for every student whereas food-related environmental issues are presented mainly in optional courses of biology and geography and teaching in the thematic entity of *Sustainable lifestyle and global responsibility* (Opetushallitus, 2015) may be neglected.

The main research questions of this study were:

RQ1. To what extent are upper secondary students aware of the environmental impacts of food?

RQ2. To what extent are upper secondary students aware of the health impacts of food?

RQ3. To what extent does the knowledge of these issues differ based on gender, study year and living area?

5.1 The extent of upper secondary students' awareness of the environmental impacts of food

As food literacy appears to be embedded into the Finnish curriculum, the first research question focused to reveal the extent of upper secondary students' critical environmental knowledge of food-related issues. The results of this study reveal the extent of upper secondary school students' awareness of the environmental effects of food. For example, they reveal that the students acknowledged food production having considerable environmental effects, the environmental importance of reducing food waste and food production and consumption contributing to climate change.

The majority of the students acknowledged food production causing notable environmental problems, which is contrary to the previous study by Pohjolainen et al. (2016), where the minority were aware of the issue. The students recognized the environmental importance of reducing food waste, which supports the previous study by Macdiarmid et al. (2016). They also acknowledged the importance of food as one of the biggest GHG sources of an average Finnish consumer, which is contrary to previous studies, where the respondents were either unfamiliar with the climatic effects of food production or underestimated food's climatic impact (Macdiarmid et al., 2016; Truelove & Parks, 2012; Vanhonacker et al., 2013).

There are several possible explanations for Finnish students being more aware of foods' warming impact than the respondents in previous studies. For instance, Finnish students may learn about issues of environmental food literacy in school or they may have confronted food-related news and information as food has been on display for example due to IPCC's Special Report on Global Warming of 1.5°C. One message of this report emphasised a reduction in the consumption of meat, which is one of the ways to decrease greenhouse gases and mitigate climate change (Masson-Delmotte et al., 2018). In addition, the amount of plant-based options has increased for example in grocery stores (see e.g. Mäki-Petäjä, 2019; Ziemann, 2016), which may have indicated the environmental friendliness of plant-based eating. Furthermore, eco-anxiety may have led even younger children to take part in climate marches and strikes (see e.g. Onali, 2019;

Sirén et al., 2019). All these above-mentioned issues may have affected to the extent of awareness among the Finnish students.

However, the awareness does not reach more specific characteristics of the environmental impacts of food as there are gaps in critical knowledge of food literacy among secondary school students. Half of the students were familiar with agriculture requiring most of the anthropogenic water consumption. Furthermore, around half or less of the students acknowledged meat production having a bigger environmental effect on the eutrophication of water systems and requiring more land area than plant production. Even fewer were familiar with the link between meat production and deforestation and the connection between soy and animal production.

In addition to gaps in food literacy, there are common misconception among the students. The majority of the upper secondary students estimated reducing packaging and avoiding imported products to be a very or quite considerable changes in food-related activities, which is in accordance with previous studies (Lea & Worsley, 2008; Macdiarmid et al., 2016; Tobler et al., 2011; Vanhonacker et al., 2013). These misconception are interesting as for the most of food products such as for cheese, broiler and cucumber, the share of the whole environmental impact of the packaging is from 0.5% to 2% whereas transportation is responsible for around 5% of food's climatic emissions (Katajajuuri, 2008; Riipi & Kurppa, 2013). Nevertheless, primary production in agriculture is responsible for most of the environmental impacts of food (Mottet et al., 2017; Riipi & Kurppa, 2013). In the case of packaging, the misconception may originate from used packaging materials being present at homes and people seeing these used packages. This may lead people overestimating the negative environmental impact of the packing (Katajajuuri, 2008). A possible explanation for the students overestimating the environmental impact of transportation may originate from the students connecting food transportation to the climatic emissions of traffic, which they acknowledged having vast GHG emissions.

As the students overestimate the importance of packaging and transportation, they appear to underestimate the importance of reducing meat consumption as around a half of the

students considered favouring vegetables instead of meat as a very considerable or a quite considerable change in diet. This finding supports the results from previous studies (Lea & Worsley, 2008; Macdiarmid et al., 2016; Tobler et al., 2011; Truelove & Parks, 2012; Vanhonacker et al., 2013). Nevertheless, the students appear to realise producing and consuming red meat warming the climate as the students chose pork and beef as the biggest GHG emitters. Still, even there is a misconception. Beef and cheese have the biggest climate impact among the products listed (see Appendix 1) as the digestive system of ruminants produces methane (CH_4) (Hallström et al., 2014).

The reason for the students underestimating the impact of a reduction in the meat consumption, and similarly realising beef as having the biggest GHG footprint, may have something to do with meat being a central ingredient in many meals. Meat is an appreciated source of protein and it is embedded into a culture and gender identity (Bohm et al., 2015; Kaljonen et al., 2018; Rothgerber, 2013). Moreover, it is possible, that the students do not consider meat as a product made from an animal (Rothgerber, 2013), whose raising has needed resources such as feed, water and land area and for example, the students may not be aware of the warming impact of methane emissions from cattle reared for food (see Appendix 1). Even if the students were aware of the environmental impact of meat, it may be moved aside as other motives for food choices are generally more important than the environment (Tobler et al., 2011).

Another interesting finding concerning GHGs is that only the minority of the students considered cheese as one of the products having the biggest climatic impact. The cheese was considered as one of the biggest GHG sources less frequently than pork, even though cheese has a higher climatic impact (see Appendix 1). One explanation for this may be that there is a lack of knowledge of the role of ruminants, such as cows, in creating greenhouse gas emissions (Hallström et al., 2014) or even lack of knowledge of milk coming from ruminants. Moreover, it is possible that the upper secondary school students are not aware of how much milk is needed to produce for example 1 kg of cheese.

What is also interesting considering the climatic impact of products, is that most of the students indicated pea and soy to have the smallest greenhouse gas emissions, yet they

considered peas more frequently climate-friendly than soy. This is interesting as both plants belong to the same family and have approximately the same direct global warming potential measured by CO_2eq/kg (see Appendix 1). Furthermore, some students considered soy as one of the products with the biggest GHG emissions. One possible explanation for this is that the students connected soy to the deforestation of tropical forests and that soy is transported from a long distance.

All in all, the extent of upper secondary students' awareness of the environmental impacts of food could be wider, but also narrower. The level of critical environmental knowledge of food literacy indicates that the students are aware of about half of the issues presented in case of environmental food production knowledge and the size of greenhouse gas emissions of distinct products. Moreover, there are some misconceptions in knowledge. A plausible explanation for this is that the statements were too specific, and that food systems and food-related issues require a deeper familiarization. It is also possible that the students do not acquire deep scientific knowledge from school for example to understand the formation of greenhouse gases.

5.2 The extent of upper secondary students' awareness of the health impacts of food

As food literacy appears to be embedded into the Finnish curriculum and environmentally burdensome food consumption is usually as well unhealthy (see Appendix 2), the second research question focused to reveal the extent of upper secondary students' critical health knowledge. This study shows, that there is a lack of knowledge among students concerning meat and common diseases.

Around half of the students were aware of meat's connection to colorectal cancer and more than a half acknowledged the connection between meat and cardiovascular diseases and type II diabetes. The students of this study were more aware of meat's connection to health issues than the respondents of a previous study on beliefs about the healthiness of

meat, where beliefs about the meat's connection to colorectal cancer and heart disease was studied (Lea & Worsley, 2002). Even so, around half of the students being aware of the issue indicates that every other student is unfamiliar with the issues. A possible explanation for these may be that common diseases, such as type II diabetes and cardiovascular diseases (Terveyden ja hyvinvoinnin laitos, 2019b), are educated in Finnish upper secondary school in a course that is obligatory for every student (Opetushallitus, 2015). Students uncertainty about meat's connection to colorectal cancer could be explained by education possibly disregarding specific types of cancer such as colorectal cancer.

On the other hand, this study also indicates that the students are familiar with food's possible health effects to some extent. The majority of students considered eating versatile vegetarian food as a healthy choice and a vegetarian diet having an improving effect on blood's fat levels. The students' belief in a vegetarian diet is consistent with that Mullee et al. (2017) and Lea and Worsley (2003b). In addition to vegetarian diet considered as a healthy diet, the majority of the students agreed on pulses, such as beans and lentils, being abundant in protein, whereas in the study by Lea and Worsley (2003a) a minority believed that a vegetarian diet contains enough protein.

An interesting result is that the students more often indicated fava bean, which is in the same family as soybeans, to be abundant in protein than soy. This is interesting because dried soybeans are more abundant in protein than dried fava bean mince (see Appendix 2). One possible explanation for this may be that the students reflect the negative environmental impacts of soy, such as deforestation and transportation, to its protein content, that is, they underestimate the protein content of soy because soy production has negative environmental impacts.

Moreover, another result considering awareness of protein content of different food products is that most of the students incorrectly considered curd cheese to be abundant in protein, although it contains less than 10 g/100 g of protein (see Appendix 2 and 9). One possible explanation is curd cheese being marketed as good sources of protein in Finland

and thus the majority of Finnish students consider it as good source of protein with fava beans and broiler breast.

One interesting finding is that mean dietary health knowledge is higher than mean environmental food production knowledge. A plausible reason for this is that food-related health issues are educated in upper secondary school more than environmental issues, even though sustainability is implemented in different subjects such as in English (Opetushallitus, 2015). This might lead to the fact that students are more aware of the relation between food and health. Moreover, in the study by Ronto et al. (2016) the respondents considered food and nutrition knowledge as important themes of food literacy, while they had a lack of knowledge concerning environmental sustainability.

5.3 The extent of knowledge differing based on gender, study year and living area

The third research question focused to reveal the extent of knowledge differing based on gender, study year and living area. One finding from this study is that environmental food production knowledge did not differ between genders. This finding is interesting as in the study by Kaljonen et al. (2018) vegetarian diet created resistance as boys defended meat and criticized vegetarian food when comparing different foods and their GHG emissions. Furthermore, the study by Kaljonen et al. also noted that rural boys most rarely chose a vegetarian meal. So, even though this thesis reveals that the male students were as aware as the female students of the environmental impacts of food, it is possible that it may not lead to pro-environmental behaviour. This may indicate that the knowledge is not enough to change attitude, which is also claimed by previous studies (see e.g. Kollmuss & Agyeman, 2002).

Another interesting finding is that females had notably higher dietary health knowledge than males. The previous study by Ronto et al. (2016) has revealed that females appreciate dietary guidelines as an important aspect of food literacy, which may explain the higher dietary health knowledge of females. On the other hand, it is possible, males having

responded to the questionnaire according to their attitudes, not according to their knowledge.

There are several explanations for females to have higher dietary health knowledge than males, which may be resulted from attitudes towards different diets. Firstly, consumption and vegetarian eating have strong meanings in our food culture and meat is a symbol for masculinity and vegetarianism is seen as feminine (Bohm et al., 2015; Kaljonen et al., 2018; Rothgerber, 2013; Ruby & Heine, 2011). Females are not questioned to be feminine or masculine according to their diet (Ruby & Heine, 2011). Secondly, males and females justify their meat consumption differently. For example, males justify their meat consumption with directs strategies, which include, for example, health reasons, attitudes that promote meat consumption, denying animal suffering, setting humans above non-human animals in the hierarchy and by people's part is to eat non-human animals. On the other hand, females use indirect strategies to justify their meat consumption. These strategies include disassociating meat from non-human animals and avoid thinking about animal mistreatment (Rothgerber, 2013). Thirdly, the living area may influence differences between genders. The previous study by Kaljonen et al. (2018) reveals that the difference between genders in the urban area was small whereas differences between genders were bigger in the rural area. These issues may have led males to defend meat and respond to the questionnaire incorrectly. As a result, males' dietary health knowledge has resulted to be lower than knowledge of females.

A third interesting finding, and an encouraging one, is that different types of critical health and environmental knowledge such as food production, dietary health and protein knowledge increase significantly from first year to third year. However, an unanticipated finding was that no increase in GHG knowledge with school years was observed. This finding does not indicate that the knowledge would be high before the students entering upper secondary school as there are gaps in the knowledge. This finding is a bit alarming as the students consider the school as the main source of food literacy although the result indicates school failing to increase GHG knowledge. The knowledge not reaching its peak also illustrates that the Internet and social media as other important sources of environmental food literacy are not enough in supporting or enhancing knowledge

concerning greenhouse gases, which implies that school should try even more in regards of increasing GHG awareness.

However, when examining the results, it is noteworthy that all the statistically significant differences are not notable, for example regarding dietary health knowledge. This means that closer inspection of the means reveals that there are no noteworthy differences between means, for example, the dietary health knowledge does not increase greatly from first year to third year. One plausible explanation concerning dietary health knowledge is that the first course of health education, in which diet promoting health benefits and common diseases are presented, is obligatory for every student. Moreover, this course is probably taken during the first year of upper secondary school studies and thus the knowledge does not increase from first year to third year. On the other hand, it is possible, that dietary health issues are part of already acquired general knowledge to some extent.

Nevertheless, there were rather ambiguous results concerning living areas. Even though several statistically significant differences were analysed between living areas as there were differences in food production, GHG, dietary health and protein knowledge, no clear pattern of increasing knowledge from rural to the urban area or the other way around was observed. For example, the students living in the Helsinki Metropolitan area, centres of population and rural area were the most aware of the environmental impact of food production, which indicates that there is no clear pattern of increasing knowledge. This is an ambiguous result as in the study by Kaljonen et al. (2018), there was a clear difference between students in the rural and urban area concerning the attitude towards vegetarian food as the students in the rural area most likely chose some other meal than the vegetarian meal during school lunch.

However, there are possible explanations for not obtaining a clear pattern in increasing critical health or environmental knowledge of food literacy from the data. Big cities may consist of different fragmented groups, which differ from another with their opinions and attitudes, cultures and identities. Moreover, people may apply to upper secondaries that are not located the closest to home and small towns may have especially students from rural areas as upper secondary schools in rural areas may be more and more infrequent.

These may influence that there is no clear observable pattern of increasing knowledge from rural to the urban area or the other way around. In addition to this, the cities differ from another, which may likewise influence the results.

6. Conclusions

The study was set out to explore the extent of upper secondary students' food literacy, and possible differences between genders, study years and living areas. This thesis has argued the importance of food literacy and presented previous studies concerning food-related critical knowledge. As a contribution to previous research, I developed a questionnaire that measures food literacy. No similar and as comprehensive questionnaire, designed to measure food-related critical environmental and health knowledge, was found from previous studies. Moreover, the questionnaire has been pretested and different sections of the questionnaire seem to measure the correct issues according to Cronbach's alpha. However, it could be beneficial to test the instrument in further researches, although the work has been initiated.

This Master's thesis study mainly supports the findings of previous studies on food-related knowledge and food literacy. The study has elucidated the range of environmental knowledge, which consists of general environmental knowledge, environmental food production knowledge and GHG knowledge. According to the results, the students considered food as one of the three biggest greenhouse gas sources of an average Finnish consumer and acknowledged the importance of food waste. However, the students overestimated the environmental impact of packaging and transported products while they underestimated the environmental impact of reducing meat consumption.

The students knew that food production causes environmental problems and they were somewhat familiar with GHG emissions of different products. Nonetheless, there were some misconceptions or lack of environmental food production knowledge since neutral responses were abundant, which may imply the complexity of food-related environmental issues (Pohjolainen et al., 2016). Even though food systems are complex, the students gained knowledge of food production from first year to third year.

The investigation of health knowledge, that consists of diet and protein knowledge, has shown that the students were somewhat familiar with health effects of food and protein content of products and the level of dietary health knowledge exceeds the level of

environmental food production knowledge. The students did not consider meat as a necessity and considered diverse vegetarian diet as healthy and pulses to contain plenty of protein. However, approximately half of the students or a bit more acknowledged the connection between meat and specific common diseases. The students underrated the protein content of soybeans in comparison to fava beans but over half of the students overrated the abundancy of protein in curd cheese. Moreover, females had higher dietary health knowledge than males and the students' protein knowledge increased from first year to third school year.

6.1 Results in terms of the school curriculum

Even though the sample may not be random due to the way of the distribution of the questionnaire and the possible skewness of the teachers that chose to conduct the questionnaire, the data is extensive, and the results give a better picture of the food literacy of the students or at least it indicates of the level of knowledge of upper secondary school students. Furthermore, the results indicate the importance of school as a source of food literacy and schools' relevance as the food literacy increases from first year to third year. The findings of this study may be utilized to improve school education of food literacy. Acknowledging the results, when planning education that touches food, health and environment, the misconceptions and gaps of knowledge can plausibly be altered.

This study has revealed the students having misconceptions although the Finnish curriculum claims to educate upper secondary students on sustainable lifestyles and global sustainability (Opetushallitus 2015). For example, the students considered reducing packaging and avoiding imported products as more considerable actions concerning the environment although the environmental impact of the actions is quite small (Katajajuuri, 2008; Riipi & Kurppa, 2013). Moreover, less than half of the students were unaware of meat production eutrophicating the water systems noteworthy more than plant production, meat production increasing deforestation, most of the soy ending up as animal feed and primary production being responsible for most of the environmental impacts of food. Moreover, the students underestimate the greenhouse gas emissions of

producing and consuming 1kg of cheese whereas quite a few of the students regard soy having big greenhouse gas emissions. As the entity of *Sustainable lifestyles and global sustainability* is claimed to be taught in Finnish upper secondary schools, it would be essential to utilize the results of this study to target the environmental misconceptions among the students and improve the level of food literacy.

Currently, as the thematic entity of *Sustainable lifestyle and global responsibility* is sprinkled over the Finnish curriculum and not fully embedded into it, food literacy may be ignored as it competes with other subjects (Nanayakkara et al., 2018). However, there are diverse ways to emphasise the importance of food literacy, increase students' critical food-related knowledge and alter misconceptions in a school environment. Firstly, embedding food literacy, especially critical environmental knowledge, into compulsory core subjects or creating a new core subject of food literacy, would improve teaching and elevate the status of food literacy. Secondly, educating and motivating teachers on food-related issues would help to increase students' food literacy and change misconceptions. Thirdly, food-related professionals aiding the planning of food literacy education would help to elevate relevant issues. However, these above-mentioned changes require resources (Nanayakkara et al., 2018) and do not guarantee increased knowledge resulting as pro-environmental (Kollmuss & Agyeman, 2002) or healthy behaviour. On the other hand, food literacy may be sufficiently educated in upper secondary schools, but the awareness does not quite deepen with study years, to which GHG knowledge about soy and cheese implies. The knowledge of the upper secondary students appears to be similar to the knowledge of civilised adult whose awareness appears to be constructed with the aid of media more than deep scientific awareness.

This study shows that dietary health knowledge of food literacy was higher than environmental food production knowledge, however, there was a gap in awareness between genders as female students were more familiar with the health effects of diet than the male students. School education could tackle this issue. For instance, teachers could question dominant ways of thinking and practices as well as they could challenge meat centred discourse with critical food literacy (Bohm et al., 2015; Kaljonen et al., 2018). Moreover, as meat is considered as a symbol for masculinity and vegetarianism considered as feminine (Rothgerber, 2013; Ruby & Heine, 2011), questioning these in

school education would be beneficial while educating students for example on sustainable lifestyles. However, to live sustainably and changing eating habits towards more sustainable is not possible for everyone as reducing of meat consumption is generally acceptable for those, who do not follow mainstream identities (Bohm et al., 2015).

Increasing the level of food literacy and filling gaps are not the only way to steer students towards pro-environmental or healthy behaviour, which is in a way the aim of educating the students on the issues. As there are many different motivators for food consumption choices, focusing on increasing food literacy is not enough. Generally, the taste is one of the main drivers for food choices (Tobler et al., 2011), but also culture and gender play a noteworthy role (Bohm et al., 2015; Rothgerber, 2013). Furthermore, the home environment may play a considerable role, even though the students are becoming more independent and moving away from childhood home (Mäkiniemi & Vainio, 2014). What can inhibit more sustainable eating besides culture and gender are lack of motivation, information about plant-based eating and skills preparing plant-based food (Lea & Worsley, 2003b), which is why increasing knowledge does not directly lead to change. To accomplish more sustainable habits and a sustainable future, more holistic actions are needed.

6.2 Limitations

There are certain limitations in this study. For example, the type of approach used in this thesis poses several limitations. Measuring critical health and environmental knowledge of food literacy with a questionnaire is one way to study the awareness of young people, however, research on lack of knowledge has been criticised (see e.g. Eden 1998). In addition, food-related knowledge is not only critical scientific knowledge, but various types of knowledge can develop in different social situations. Knowledge can also be for example functional, which refers for example to food-related skills (Truman et al., 2017), as previously mentioned. Nevertheless, the approach of this study is justified as one aim of upper secondary education is to strengthen wide-ranging general knowledge (Opetushallitus, 2015). Hence, the study supplements qualitative research such as

research on the development of student's relationship to food and the environment (see e.g. Kaljonen et al., 2018).

Moreover, there are limitations regarding spreading the questionnaire. The rate of response per cent N is unknown because of the way the questionnaire was spread, which is why the reliability cannot be calculated. As previously mentioned, the teachers' motivation in conducting the questionnaire to the students possibly influenced the spread of the questionnaire and to the student participation. The population of the teachers may have been skewed, for example, teachers interested in food-related environmental or dietary health issues, who may emphasise these issues in teaching, may have been more prone to conduct the questionnaire to the students. This again influenced on the sample, which was not random, and to the nonresponse.

In addition, there are and may be problems with the groups. For instance, the group of fourth-year students, who have extended their studies from common three years of studying, was a too small group to study concerning other groups. Therefore, no conclusions based on this group could have been drawn using ANOVA analysis. Besides, it may be questioned if the students knew to which group of living areas they belonged to and how they have chosen the group. This may have affected the analysis between living areas.

It is also noteworthy that the students may have given responses without deeper consideration. For example, "I cannot say" -response is tempting (Heikkilä, 2014). Moreover, it can be questioned, if a questionnaire measures knowledge properly and how easy it is to reliably measure food literacy of students. For example, some male students gave some impertinent responses and may not have answered to the questionnaire according their knowledge.

Several questions remain unanswered. A question raised by this study is what creates the difference in dietary health knowledge between genders, which would be an intriguing area for further work. Moreover, the issue of living area could be further investigated, as no outstanding differences in food-related awareness between students from different

living areas or a clear pattern of knowledge increasing for example from rural to the urban area were found. This would be interesting for further studies as the study by Kaljonen et al. (2018) revealed differences between living areas even though it did not emphasise knowledge per se.

All in all, this study should be repeated to further test the questionnaire and the measurer created. Moreover, the emergence and development of food literacy should be studied, for example how knowledge and attitudes interact and how school and other sources of food literacy interact in the creation and development of food literacy. Also, it would be fruitful to study the development of understanding and readiness of students by combining quantitative and qualitative research.

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Appendices

APPENDIX 1

Environmental effects of food

Food production and consumption affects on the environment, for example food production is connected to water and land use. Agriculture uses around 69% of extracted fresh water and accounts 70% of global water withdrawals (FAO, 2016; FAO, 2017; Gladek et al., 2017). It takes about 70% of agricultural land and approximately 30% of the land area of the Earth (Mottet et al., 2017; Steinfeld et al., 2006). Whereas production of 1 kg of boneless beef requires approximately 31 m² of land area, producing 1 kg of boneless pork requires 10 m² and 1 kg of chicken 7 m² (Hallström et al., 2014). Growing meat production and consumption is linked to deforestation (Mottet et al., 2017; Steinfeld et al., 2006), which leads to biodiversity loss and land degradation (McMichael et al., 2007; Mottet et al., 2017; Steinfeld et al., 2006).

Food production releases different substances to the environment such as nutrients and greenhouse gases. Nutrients, like nitrogen, eutrophicates water systems (Steinfeld et al., 2006) and the eutrophicating impact, nitrogen footprint, depends of the food product. For example, red meat and dairy products require more nitrogen than cereals (Xue, 2010). Moreover, agriculture, notably livestock, creates about 20% of global greenhouse gas emissions and contributes to climate change (McMichael et al., 2007). Livestock is responsible of 9% of carbon dioxide, 37% of methane and 65% of nitrous oxide (Steinfeld et al., 2006). Different food products have distinct greenhouse gas emissions, which can be presented in kg CO_2-eq/kg produce or bone free meat (BMF) across various food types (see Table 5) (Clune et al., 2017).

Food production has also positive impacts on the environment, for example cows grazing in traditional rural biotopes maintain biodiversity as they prevent the range and meadow from overgrowing (Maa- ja metsätalousministeriö, 2019a). Furthermore, growing production animals is part of food security and source of income as animals can use pastures, and convert grass into milk and beef, that would not be suitable for cultivating plants for human consumption (Luonnonvarakeskus, 2019; Mottet et al., 2017).

Table 6 Summary of greenhouse gas emissions per product (kg CO_2eq/kg product or bone free meat in different food types. Source: Clune et al., (2017)

Product	Mean
Beef	28.73
Cheese	8.86
Pork	5.85
Chicken	4.12
Salmon	3.76
Pea	0.60
Soybean	0.58

APPENDIX 2

Health effects of food

Global meat consumption has increased, and it is likely to increase in future (Henchion et al., 2014). In European Union, people consumed meat approximately 79 kg/capita/year (FAO, 2019), whereas in Finland people consumed approximately 81 kg of meat per person in year 2017. Finnish people consume bone-in beef approximately 19,4 kg, pork 33,4 kg and poultry 24,9 kg per person (Luonnonvarakeskus, 2018). Meat is a good and valued source of protein and it is abundant in well absorbing iron (Valtion ravitsemusneuvottelukunta, 2014).

The way people consume food endangers health of people (Fischer & Garnett, 2016). According to Finnish nutrition recommendations (2014), people who consume a lot of red and processed meat have more colorectal cancer, type II diabetes, obesity and coronary artery disease (Valtion ravitsemusneuvottelukunta, 2014; McMichael et al., 2007). The Finnish nutrition recommendations advice that people should not exceed the intake of red and processed meat over 500 grams per week. In Western people in general, diabetes mellitus, obesity and cardiovascular diseases tend to be less frequent for people who have a vegetarian diet. Vegetarians have better blood fat levels and the blood pressure is lower (Valtion ravitsemusneuvottelukunta, 2014).

Table 7 The protein content of different products. Source: Terveyden ja hyvinvoinnin laitos (2019a)

Product	**Protein content**
Dried soybeans	35.88 g/100 g
Dried fava bean mince	28.53 g/100 g
Uncooked broiler breast	22.44 g/100 g
Curd cheese	9.81 g/100 g
Cream for cooking	2.70 g/100 g
An apple	0.17 g/100 g

APPENDIX 3

The questionnaire

Hyvä lukiolainen!

Tällä kyselyllä selvitetään, millaisia ovat lukiolaisten käsitykset ruoan ympäristö- ja terveysvaikutuksista. Vastaa kyselyyn oman tietämyksesi mukaan.

Vastaukset kerätään lomakkeen avulla ja ne käsitellään luottamuksellisesti. Vastaajan henkilöllisyys ei tule julki missään vaiheessa. Kyselylomakkeen täyttämiseen kuluu aikaa noin 10 minuuttia. Kyselyyn vastaaminen on vapaaehtoista ja sinulla on oikeus jättää vastaaminen kesken missä tahansa vaiheessa.

Kyselyn termien selitykset:

*Ympäristöllä tarkoitetaan luonnonympäristöjä, kuten metsiä ja vesistöjä.

*Luonnon monimuotoisuus tarkoittaa erilaisten eliölajien, elinympäristöjen ja geenien määrää..

*Kasvisruokavaliolla tarkoitetaan ruokavaliota, joka ei sisällä lihaa eikä kalaa.

Kiitos osallistumisestasi!

Lukiolaisten käsitykset ruoan ympäristö- ja terveysvaikutuksista

1. Mitä sinun mielestäsi on ympäristöystävällinen ruoka? Perustele vastauksesi lyhyesti.

_____
_____

2. Valitse listalta kolme suurinta keskimääräisen suomalaisen kuluttajan kasvihuonekaasulähdettä.

a. Liikenne

b. Matkailu

c. Asuminen

d. Ruoka

e. Kodin tavarat ja vaatetus

f. Harrastukset

3. Arvioi. Kuinka merkittäviä seuraavat muutokset ruokavalinnoissa ovat ympäristön kannalta? (5 = erittäin merkittävä, 4 = melko merkittävä, 3 = hieman merkittävä, 2 = vain vähän merkittävä, 1 = ei lainkaan merkittävä, 0 = en osaa sanoa)

a. Ruokahävikin vähentäminen

b. Pakkausmateriaalien vähentäminen

c. Kaukana tuotettujen elintarvikkeiden välttäminen

d. Kasvisten suosiminen lihan sijaan

e. Luomun suosiminen

4. Alla on väittämiä. Pitääkö väittämä paikkansa? Merkitse vastaus oman tietämyksesi mukaan. Vastausvaihtoehdot (kyllä; ei; en tiedä)

a. Ruoantuotanto aiheuttaa merkittäviä ympäristöongelmia*

b. Ruoantuotanto vaikuttaa monimuotoisuuden vähenemiseen

c. Valtaosa ihmisten käyttämästä makeasta vedestä kuluu ruoantuotantoon

d. Kasvintuotanto aiheuttaa lihantuotantoon verrattuna merkittävästi enemmän vesistöjen rehevöitymistä

e. Lihantuotanto lisää metsäkatoa

f. Valtaosa soijasta päätyy eläinten rehuksi.

5. Valitse seuraavista vaihtoehdoista kaksi, joilla on suurimmat kasvihuonekaasupäästöt.

(herne 1kg; juusto 1kg; sianliha 1kg; soija 1kg; naudanliha 1kg; broilerinliha 1kg; lohifile 1kg; en tiedä)

6. Valitse seuraavista vaihtoehdoista kaksi, joilla on pienimmät kasvihuonekaasupäästöt.

(herne 1kg; juusto 1kg; sianliha 1kg; soija 1kg; naudanliha 1kg; broilerinliha 1kg; lohifile 1kg; en tiedä)

7. Kumman tuotanto vaatii enemmän maa-alaa: kasvisruoan vai liharuoan?
(Vastausvaihtoehdot: kasvisruoan, liharuoan, ne vaativat saman verran, en tiedä)

8. Kummasta syntyy valtaosa ruoan ympäristövaikutuksista?

Kuvaus: *Alkutuotannolla tarkoitetaan kasvatusta, viljelyä, sadonkorjuuta, lypsämistä ja kaikkia eläintuotannon vaiheita ennen teurastusta. Alkutuotantoa ovat esimerkiksi lihakarjan kasvatus, kasvisten ja viljan viljely.

-Pakkaamisesta ja kuljetuksesta

-Alkutuotannosta

-En osaa sanoa

8. Onko seuraavissa runsaasti >20g/100g vai vähän/kohtuullisesti <20g/100g proteiinia? (vähän/ kohtuullisesti (< 20 g/100g); runsaasti proteiineja (>20 g/100 g); en tiedä)

-100 g kuivattua härkäpapurouhetta

-100 g kuivattuja soijapapuja

-100 g broilerin rintafile, kypsentämätön

-100 g ruokakermaa

-100 g maitorahkaa

-100 g omenaa

9. Alla on väittämiä. Pitääkö väittämä paikkansa? Merkitse vastaus oman tietämyksesi mukaan. Vastausvaihtoehdot (kyllä; ei; en tiedä)

a. Liha on välttämätön osa terveellistä ruokavaliota

b. Punaista lihaa ja etenkin lihavalmisteita runsaasti kuluttavilla esiintyy enemmän paksu- ja peräsuolisyöpää.

c. Tyypin II diabeteksen riski kasvaa syömällä runsaasti punaista lihaa ja lihavalmisteita

d. Sydän- ja verisuonisairauksien riski vähenee syömällä vähemmän punaista lihaa ja lihavalmisteita

e. Lihassa on erityisen runsaasti hyvin imeytyvää rautaa

f. Palkokasveissa, kuten pavuissa ja linsseissä, on runsaasti proteiinia

g. Kasvisruokavaliolla on veren rasva-arvoja parantava vaikutus

h. Monipuolisesti koostettu kasvisruokavalio on terveellinen

10. Ruokavalinnat. Vastausvaihtoehdot (5 = täysin samaa mieltä; 4 =osin samaa mieltä; 3= ei samaa eikä eri mieltä; 2= osin eri mieltä; 1= täysin eri mieltä; 0 = en osaa sanoa)

-Voin vaikuttaa ruokavalinnoillani ympäristöön

-Voin vaikuttaa ruokavalinnoillani terveyteeni

11. Mitä sinun mielestäsi pitäisi tehdä ympäristöystävällisen ja terveellisen ruoan kulutuksen lisäämiseksi? Kenen vastuulla näet tämän olevan?

_____
_____

12. Mistä olet saanut eniten tietoa ruoan ympäristövaikutuksista? Valitse 1-3.

-koulu

-koti

-tiedotusvälineet, kuten esimerkiksi televisio tai sanomalehti

-sosiaalinen media

-kaverit

-mainonta

-internet

-muu, mikä?

13. Mistä olet saanut eniten tietoa ruoan terveysvaikutuksista? Valitse 1-3.

-koulu

-koti

-tiedotusvälineet, kuten esimerkiksi televisio tai sanomalehti

-sosiaalinen media

-kaverit

-mainonta

-internet

-muu, mikä?

13. Mikä seuraavista kuvaa suhdettasi lihankulutukseen?

-En syö lihaa

-Syön lihaa, mutta olen tietoisesti vähentänyt lihankulutustani

-Syön lihaa, mutta olen aikeissa vähentää lihankulutustani

-Syön lihaa ja aion jatkossakin syödä saman verran kuin nyt

-Syön lihaa ja aion lisätä lihankulutustani

14. Millä seuraavista perustelisit vastaustasi edelliseen kysymykseen? Valitse enintään kolme tärkeintä asiaa.

-Maku

-Hinta

-Ympäristö

-Terveys

-Eläinten hyvinvointi

-Muu syy, mikä?

15. Omat tiedot

a. Sukupuoli

-Nainen

-Mies

-Muu

b. Syntymävuosi

c. Koulun nimi

c. Luokka-aste

-1 luokka

-2 luokka

-3 luokka

-Muu, mikä?

d. Asuinkunta

e. Asuinympäristö

-Maaseutu

-Taajama tai pienehkö kaupunki

-Kaupunki 20 000-100 000 asukasta

-Kaupunki yli 100 000 asukasta

-Pääkaupunkiseutu

f. Ruokavalio

-syön lihaa joka päivä tai lähes joka päivä (sekasyöjä)

-syön lihaa muutaman kerran viikossa (sekasyöjä)

-syön lihaa harvemmin kuin kerran viikossa (sekasyöjä)

-en syö lihaa ollenkaan (olen kala-kasvissyöjä eli käytän kalaa, maitotuotteita ja/tai kananmunia)

-en syö lihaa ollenkaan (olen kasvissyöjä eli käytän maitotuotteita ja/tai kananmunia)

-en syö lihaa ollenkaan (olen vegaani eli en syö mitään eläinperäistä)

-en osaa sanoa

g. Lähipiirissäni (perheessä tai ystäväpiirissä) on kasvissyöjiä

-0

-1

-2 tai enemmän

APPENDIX 4

Sociodemographic characteristics of the sample

Table 8 Sociodemographic characteristics of the sample, sample size (n) = 1320

Sociodemographic characteristic	% of total
Gender	
Male	35.2
Female	61.7
Other	3.1
Total	100
School year	
First year	56.1
Second year	34.1
Third year	8.4
Fourth year	0.7
Missing system	0.7
Total	100
Living area	
Helsinki Metropolitan Area	23.1
City (>100 000 residents)	15.2
City (20 000-100 000 residents)	13.7
Centre of population or a small town	30.0
Rural area	18.0
Total	100

APPENDIX 5

Importance of different changes in diet in relation to the environment

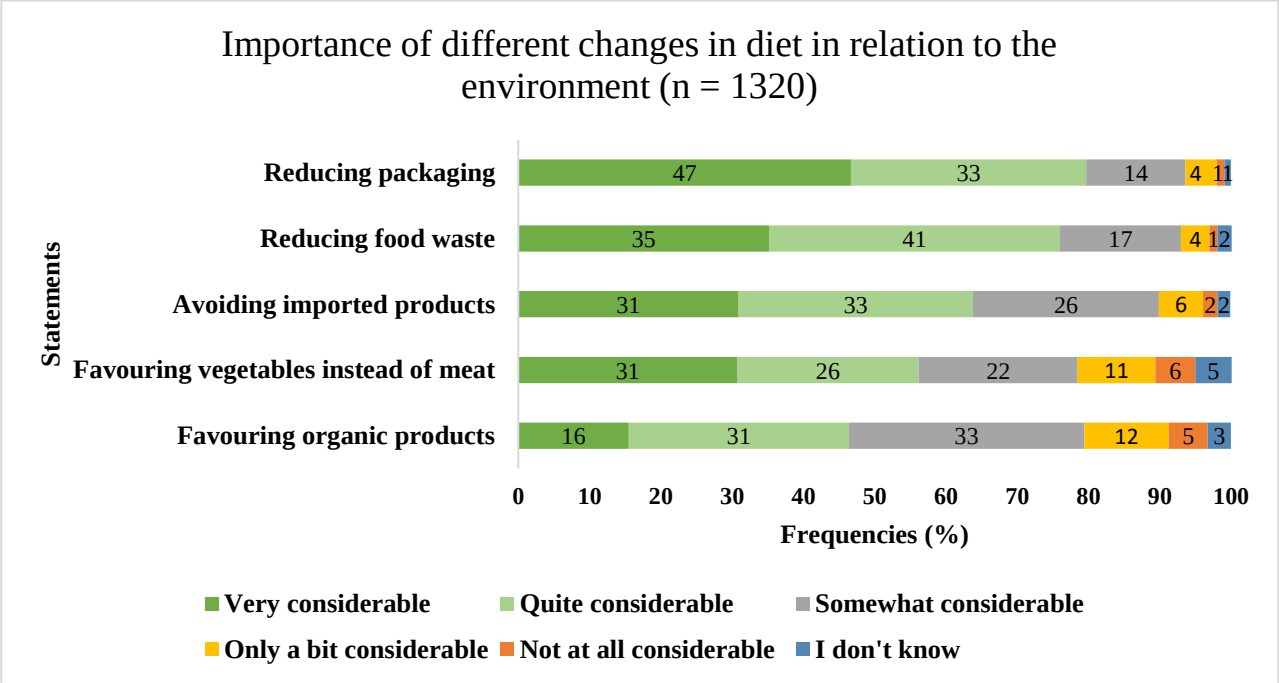

Figure 1 The share (%) of the students who evaluated the importance of different changes in diet in relation to the environment either very considerable, quite considerable, somewhat considerable, only a bit considerable and not at all considerable. "I don't know" -option was also included.

APPENDIX 6

Environmental food production knowledge

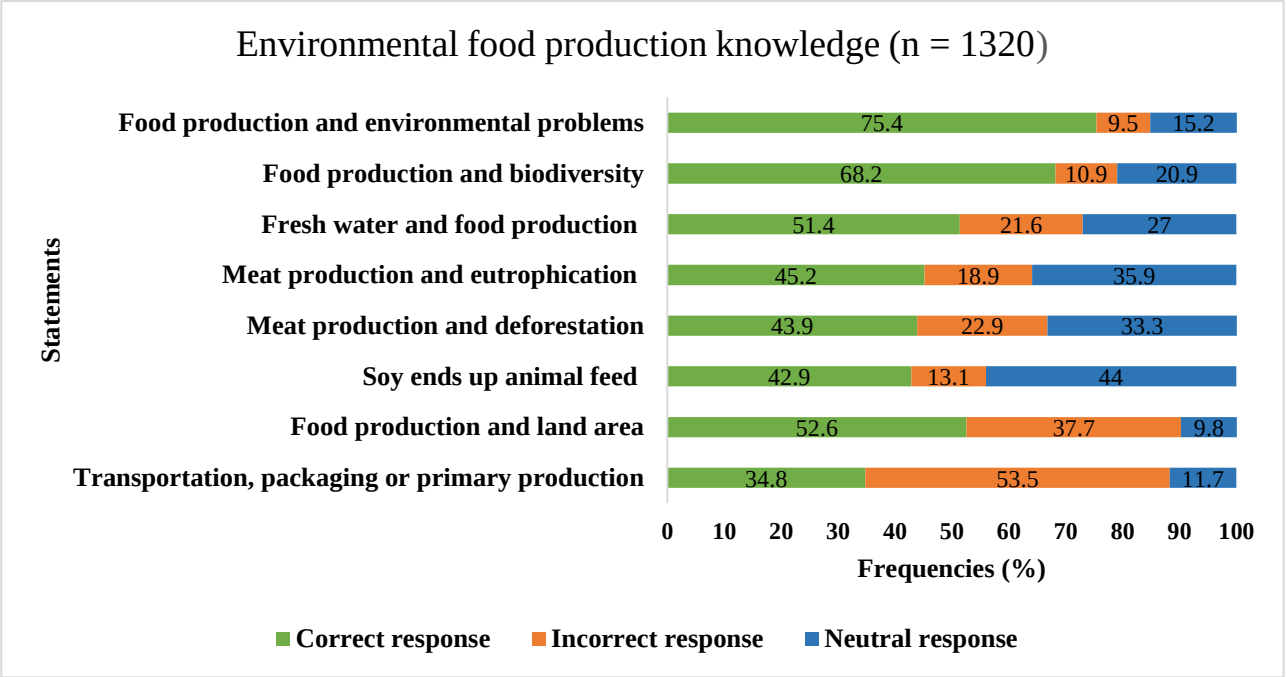

Figure 2 The share (%) of the students who chose correct, incorrect or neutral response. The statements are found in Table 1.

In order to measure environmental food production knowledge, eight items were formed to which students were to either agree or disagree, to which "I don't know" option was included to reduce random guessing. The last two items of this section were slightly different than the preceding six statements, as the amount of response options varied, or the form of question was dissimilar which influenced to the response options (see Appendix 3). The first item of these two emphasised the issue of land area needed to produce food. In the questionnaire it was asked: "Which's production required more land area: to produce plants or meat?". This item had four response options: to produce plants, to produce meat, they require the same amount of land area, and "I don't know". To the second item asked students to examine, which produces most of the environmental impact of food: primary production or transportation and packaging, with three response options. The response options were packaging and transportation, primary production and "I don't know".

APPENDIX 7

GHG knowledge

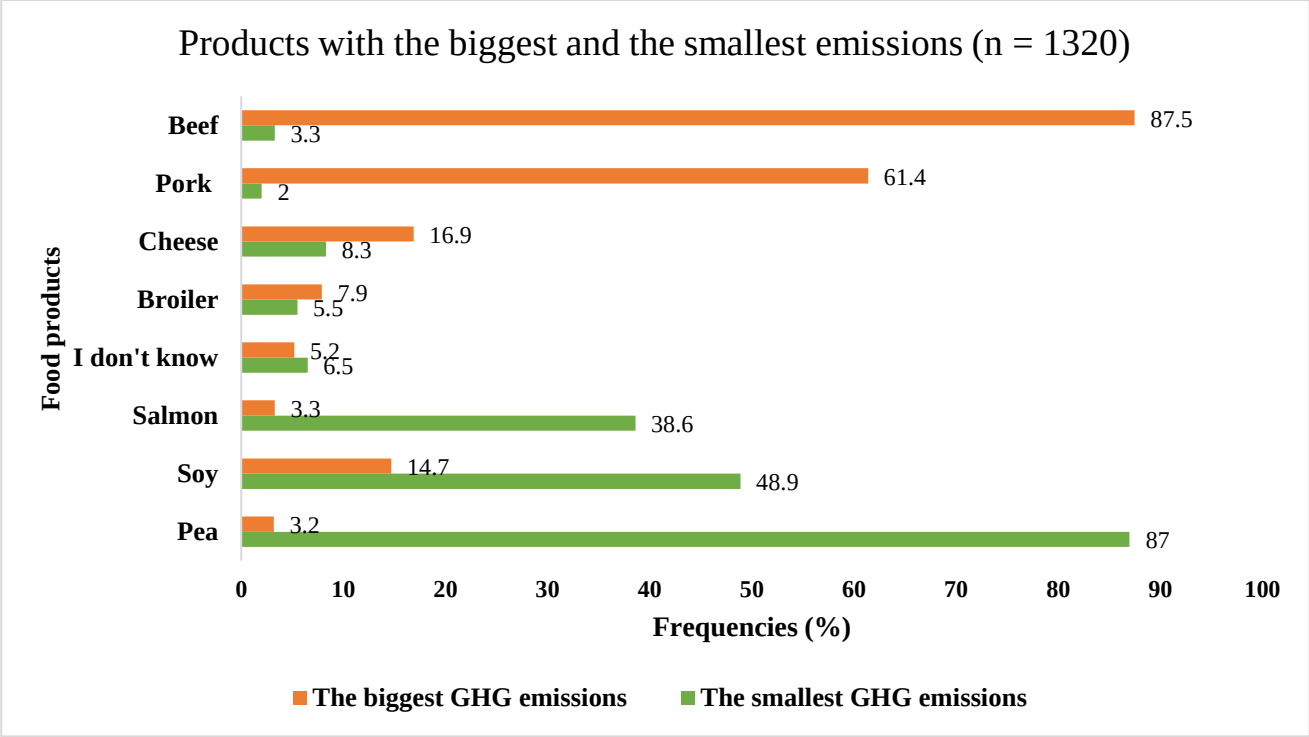

Figure 3 The share (%) of the students that indicated product to have a big or a small GHG emissions.

APPENDIX 8

Dietary health knowledge

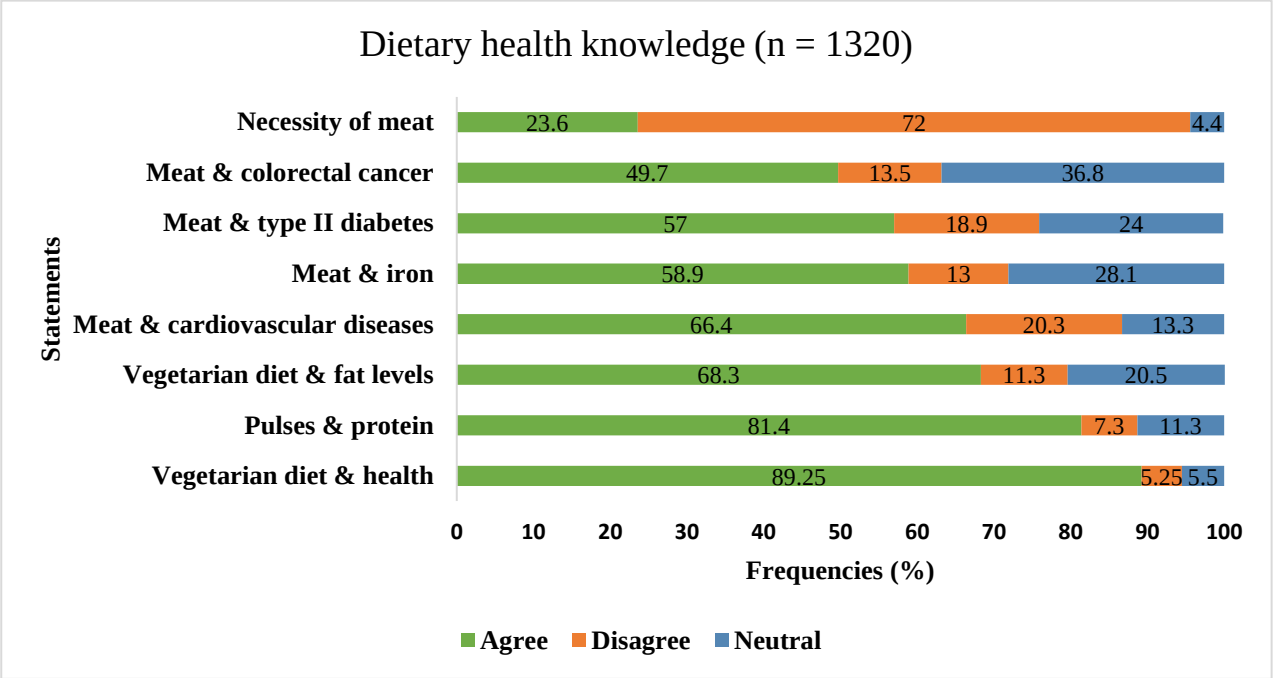

Figure 4 The share (%) of the students who agree, disagree or are neutral with the statements. Statements are found in Table 1.

APPENDIX 9

Protein knowledge

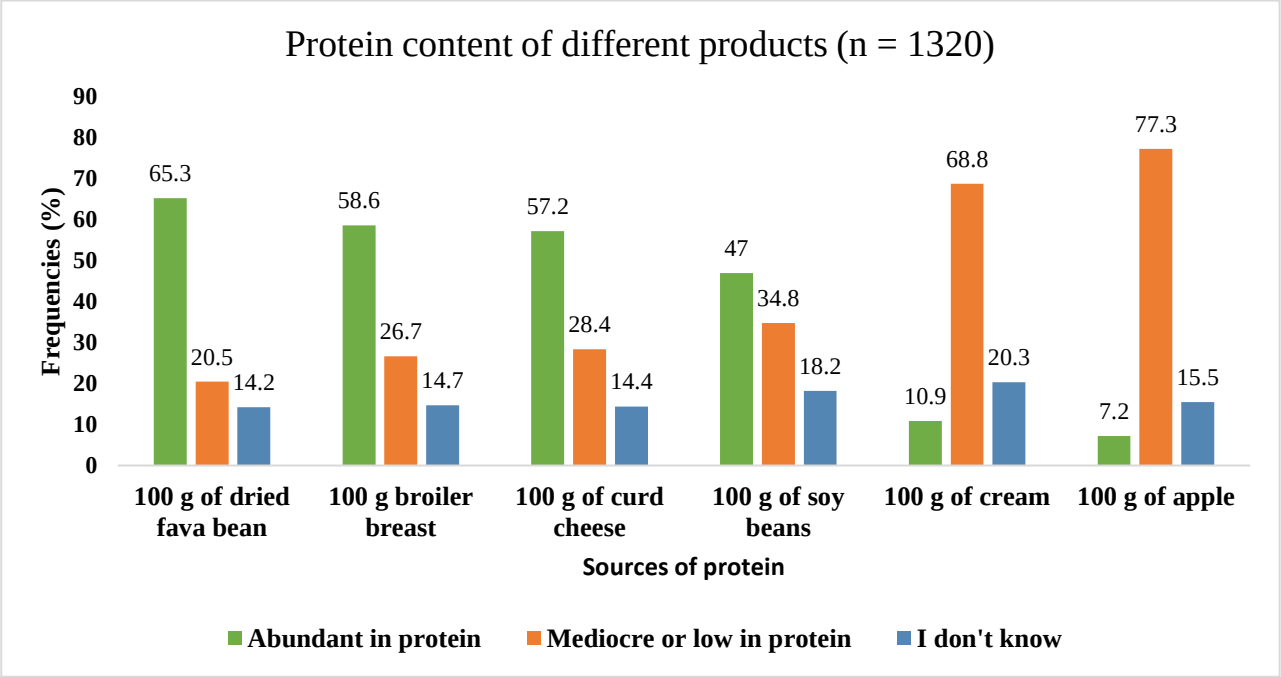

Figure 5 The share (%) of the students who think a food product is abundant in protein, mediocre or low in protein, or do not know.