

Iftexhar Hasan

# **FACTORS ASSOCIATED WITH PURCHASING TRENDS OF MILKS AND PLANT-BASED DRINKS**

An analysis of purchase patterns among Finnish loyalty  
cardholders

Faculty of Social Sciences  
Master's Thesis  
June 2024

# ABSTRACT

Iftekhhar Hasan: Factors associated with purchasing trends of milks and plant-based drinks (An analysis of purchase patterns among Finnish loyalty cardholders)  
Master's Thesis - Monograph  
Tampere University  
Master's Degree Program in Public and Global Health  
June 2024

---

Milk has been recognized as an important source of essential nutrients for over centuries. However, consumers are choosing plant-based alternatives due to worries about the environment and health complications like lactose intolerance or milk protein allergy. Plant-based drinks obtained from soy, almond, rice, and oat are becoming more and more popular substitutes for liquid milk because of their improved flavor over the past decade, advantages for animal welfare, and ethical issues. There has been a decline in the consumption of dairy milk in Finland over the last few decades, and the reasons for the decline remain largely unexplored, particularly with regard to the impact of sociodemographic factors on long-term purchasing patterns. This study aims to explore the purchasing patterns of liquid milk and plant-based drinks and how these purchasing patterns are associated with the sociodemographic factors of Finnish loyalty cardholders.

The data for this study came from S Group's loyalty cardholder customers' grocery purchases of liquid milks and plant-based drinks from September 2016 to December 2018. Participants included in this study ( $n = 23,215$ ) answered the background questionnaire, which included information on their sociodemographic characteristics, and it was combined with the automatically accumulated liquid milk and plant-drinks purchase data who had the loyalty of at least 61%. Any customer who had missing data for sociodemographic factors was excluded, and 21,668 customers were selected for further analysis of this study. Monthly purchases of different liquid milks and plant-based drinks were calculated and used to analyze the purchasing patterns. The purchasing volume for liquid milk and plant-based drinks was explored according to the different sociodemographic characteristics of the loyalty cardholders. Linear mixed effects model (LMM) was used by using 28 months as a repeated measure, to examine the association between the monthly purchase and the chosen sociodemographic factors (sex, age, and education). Separate models were built for each predictor including time, the predictor, and their interaction.

Semi-skim and skimmed milk were the most popular choices among Finnish loyalty card holders, while purchases of skim milk were marginally declining. There was a noticeable increase in plant-based drink purchases, indicating a change in customer preferences. Other milk types showed fluctuating trends over time, and whole milk was purchased more during the winter holiday season. Over time, liquid milk purchases decreased ( $\beta = -0.028$ ,  $p < 0.001$ ) and plant-based drinks purchases increased ( $\beta = 0.011$ ,  $p < 0.001$ ). Males purchased more liquid milk ( $\beta = 0.683$ ,  $p < 0.001$ ) and plant-based drinks ( $\beta = 0.800$ ,  $p < 0.001$ ) than females, but the effect of time on purchased volume is the same for both males and females and no interaction with time and sex. Younger customers (age 18-29) purchased fewer liquid milk products compared with older customers (age 60 or more), but the trend was slightly increasing over time ( $\beta = 0.017$ ,  $p = 0.04$ ). However, middle-aged customers (age 40-59) dominated the purchasing patterns with a higher volume of liquid milk and plant-based drinks. Customers with a higher level of education purchased fewer liquid milk products and more plant-based drinks meaning that purchasing trend over time differed by education.

In conclusion, this study investigated the associations of sociodemographic factors on the purchasing patterns of liquid milk and plant-based drinks for Finnish loyalty cardholders. The decline in overall liquid milk purchases and the increase in plant-based drink purchases were related to sex, being more educated, and being relatively middle-aged. These patterns might not be generalized to other developing or underdeveloped countries as the dataset was dominated by women, highly educated or middle-aged customers. This provides the opportunity to conduct further research to understand how customer preferences for liquid milk and plant-based drinks will change in the future.

Keywords: Liquid milk trends, plant-based drinks trends, sociodemographic factors

The originality of this thesis has been checked using the Turnitin Originality Check service.

## TABLE OF CONTENTS

<b>1. INTRODUCTION</b> .....	1
<b>2. REVIEW OF LITERATURE</b> .....	3
<b>2.1 Dairy milk consumption</b> .....	3
2.1.1 Historical trends of milk consumption globally.....	3
2.1.2 Milk consumption trends in Finland.....	4
2.1.3 Nutritional and health aspects of milk consumption.....	5
2.1.4 Milk consumption and sustainability.....	9
<b>2.2 Plant based milk alternatives</b> .....	10
2.2.1 Processing and innovations of plant-based milk alternatives.....	10
2.2.2 Nutritional comparison of dairy milk and plant-based milk alternatives.....	12
2.2.3 Challenges and opportunities of plant-based milk alternatives.....	15
<b>2.3 Factors associated with consumption of milk and plant-based milk alternatives</b> .....	16
2.3.1 Factors associated with milk consumption.....	16
2.3.2 Factors associated with plant-based milk alternatives consumption.....	17
<b>2.4 Highlights of emerging issues and the value of the research work</b> .....	18
<b>3. AIMS/RESEARCH QUESTIONS</b> .....	20
<b>4. MATERIALS AND METHODS</b> .....	21
4.1 Study design and participation.....	21
4.2 Variables.....	23
4.3 Statistical methods.....	24
4.4 Ethical aspects.....	26
<b>5. RESULTS</b> .....	27
5.1 Characteristics of the participating loyalty cardholders.....	27
5.2 Purchasing trends of different types of milks and plant-based drinks.....	29
5.3 Socioeconomic factors associated with liquid milk and plant-based drinks	

purchase patters.....	32
<b>6. DISCUSSION.....</b>	<b>41</b>
6.1 Purchasing trends of liquid milks and plant-based drinks.....	41
6.2 Demographic and socioeconomic factors associated with liquid milk and plant-based drinks purchase trends.....	43
6.3 Strengths and limitations of the study.....	46
6.4 Recommendations and suggestions for future work.....	48
<b>7. CONCLUSION.....</b>	<b>49</b>
<b>REFERENCES.....</b>	<b>50</b>
<b>APPENDICES.....</b>	<b>62</b>

## 1. INTRODUCTION

Milk consumption has long been an integral component of diets, with dairy milk products contributing significantly to the provision of vital nutrients including calcium, vitamin D, and minerals for centuries (FAO, 2013; Pereira, 2014). Milk intake has historically differed significantly between different populations and geographical regions over the years (Islam et al., 2021; Kumar et al., 2014). Even though some developing nations have seen a substantial rise in dairy product consumption in recent decades due to economic growth, urbanization, and rising income levels, there are still notable differences in per capita consumption levels between developed and developing nations (Gerosa & Skoet, 2012). Future projections indicate that developing countries will continue to see an increasing pattern in milk consumption compared to developed countries, and this trend might have a potential economic impact on farmers and food processors (Henchion et al., 2021).

The nutritional composition of dairy milk emphasizes that it is a well-balanced food that is full of vital elements, earning it the title of nature's most nearly perfect food (Park & Haenlein, 2013). However, with many other essential nutrients, milk also contains lactose as its main source of carbohydrate, which can cause digestive issues in many individuals (Silva et al., 2020). Additionally, many consumers are now concerned about the environmental effects of dairy production, including greenhouse gas emissions, water use, and land damage (Ahmad et al., 2023).

Conversely, plant-based drinks provide an alternative for consumers to avoid the complications of lactose intolerance and milk protein allergies (Haas et al., 2019). The rise of plant-based drinks has shown emerging popularity in the last decade, as these liquid milk alternatives obtained from sources like rice, oats, almonds, and soy are becoming more and more popular among customers looking for healthier, more environmentally friendly solutions (Vanga & Raghavan, 2018). Moreover, the continuous development and innovation of plant-based drinks with enhanced flavor, taste, and texture are attracting a wider consumer base (Mehany et al., 2023; Sethi et al., 2016). Overall, plant-based milk substitutes require less land and water and emit less

greenhouse gases, leaving a smaller environmental impact compared to dairy milk production (Tachie et al., 2023).

Numerous factors that affect dairy milk consumption have been identified by researchers, such as households having more children drink a larger amount of milk or consumers being greatly influenced by health consciousness and understanding the value of dairy milk's nutritional content (Boniface & Umberger, 2012; Kapaj & Deci, 2017). However, dairy milk consumption in Finland has been decreasing over the years, similar to other developed countries (Natural Resources Institute Finland, 2024); hence, it would be interesting to explore the potential reasons behind this tendency. Although studies were conducted to identify the underlying factors associated with decreased milk consumption and rising demand for plant-based alternatives throughout the world, very few studies have focused on longitudinal data structures, revealing the interactions of time and sociodemographic factors like sex, age, education, and income responsible for the change in dietary practices. Most of the research relied on questionnaires, while automated customer data collection may yield more accurate results in terms of understanding yearly and long-term purchasing trends.

The purpose of this study is to explore the trends in the purchases of various dairy milk products and plant-based milk alternatives, as well as to examine the associations between these purchases and the sociodemographic characteristics of Finnish loyalty cardholder consumers.

## **2. REVIEW OF LITERATURE**

The review of literature focuses on different perspectives on dairy milk consumption, trends in milk consumption, nutritional composition, and health benefits in the following sections. After that, the idea and innovation of plant-based milk alternatives will be discussed, along with a comparative view of their use as a replacement for dairy milk. Additionally, this review will emphasize the relevant factors associated with dairy milk and plant-based milk alternatives consumption. Lastly, but not least, important points related to the issues studied in the relevant literature will be highlighted, and the potential gaps that are key for conducting this research will be explained.

### **2.1 Dairy milk consumption**

#### **2.1.1 Historical trends of milk consumption globally**

Consumption of milk has differed between different regions and populations around the world. Gerosa and Skoet (2012) have discussed the dairy production and consumption trends in their review paper with the comparison of developed and developing nations in the world. Although, the consumption of dairy products has increased rapidly in the past few decades in some developing countries because of economic expansion, urbanization, and rising income levels; there are still significant disparities in per capita consumption levels between developed and developing countries (Gerosa & Skoet, 2012). According to the review of Gerosa and Skoet (2012), in 1987, the lowest milk consumption was found in East and Southeast Asia region (6.4 kg/capita/year) and the highest was in developed region (208.7 kg/capita/year). However, within two decades milk consumption in 2007 showed nearly similar for developed regions (213.7 kg/capita/year) but an increasing trend in the developing regions including East and Southeast Asia (24.9 kg/capita/year) (Gerosa & Skoet, 2012). The increasing dairy consumption trend in developing countries could enhance the incomes of underprivileged farmers or food

processors in developing countries and could give them a unique chance to capitalize on the rapidly growing livestock industry by providing their families with a reliable supply of high calories and micronutrients (Delgado, 2003).

Henchion et al. (2021) have reviewed the Food and Agriculture Organization of the United Nations (FAO) Food Balance Sheet data (2000-2017) to predict milk consumption for the next decades. Based on the prediction of their article, milk consumption will increase more in the developing countries compared to the developed countries. As an illustration of this verdict, evidence from Canada as a developed country in North American region and India as a developing country in South Asian region could be used. In Canada, consumption percentage of plain milk has decreased from 70.2% to 56.1% during 2004 to 2015 and plant-based beverages consumption has increased from 1.8% in 2004 to 3.0% in 2015 (Islam et al., 2021). On the other hand, milk consumption data in India from 1983 to 2010 has shown that there is an increasing trend in both rural and urban areas (Kumar et al., 2014). However, increased demand for milk and dairy products should be considered in the planning of developing countries to meet the challenge of a growing population (Henchion et al., 2021; Kumar et al., 2014).

### 2.1.2 Milk consumption trends in Finland

As discussed in the previous section, milk consumption is decreasing in the developed countries and the situation is not different in Finland also. The Natural Resources Institute Finland (Luke) (2024) has listed the data from 1990 to 2022 for the five types of milk available for consumption in Finland: farm milk, whole milk, low-fat milk, skimmed milk, and sour milk. Among them, farm milk is the least consumed milk, and low-fat milk is the highest consumed milk. According to their listing, milk consumption has decreased slowly from 1990 to 2022, and the trend is similar for all five types except skimmed milk, with slight or negligible exceptions in some years. Their food balance table has shown that in 1990, per capita by year consumption of low-fat milk was 101 kg, whole milk 35.7 kg, and skimmed milk 29.2 kg. However, whole milk and low-fat milk consumption have declined over the years, and in 2022, consumption for whole

milk has decreased to nearly one-third and for low-fat milk, nearly half of the amount of 1990. The only surprising trend in their food balance table was the trend for skimmed milk as it increased to 54.9 kg per capita per year in 2009 and then gradually decreased to 28.4 kg per capita per year in 2022 (Natural Resources Institute Finland, 2024).

Lyytikäinen et al. (2005) have conducted a cross-sectional study on the milk consumption of early pubertal girls in central Finland. According to their findings, milk consumption was high among most of them, except for a portion of them following dairy restricted diet, who consumed more non-milk beverages to make up for their low intake of milk products. Improving the diet quality along with milk intake could be done by focusing not only on the children but also by assessing the diet quality of the whole family (Kyttälä et al., 2010).

### 2.1.3 Nutritional and health aspects of milk consumption

Milk composition usually contains water, carbohydrate, fat, water and fat soluble vitamins, minerals. Pereira (2014) has highlighted the nutritional composition of dairy milk and the comparison of its components between cow, sheep, goat and human milk. According to his listing, sheep milk had the highest protein and fat content and goat milk showed higher amount of A, B1 and B12 vitamins. Usually, cow milk which is also known as bovine milk, is widely popular and consumed all over the world and on average it is composed of 87% water, 4 – 5% lactose, 3% protein, 3 – 4% fat, 0.1% vitamins, and 0.8% minerals (Pereira, 2014). Depending on the fat content of milk, it is classified into three categories as whole milk, low-fat milk or semi skimmed milk, and skimmed milk.

**Table 1:** Average nutritional composition of whole, low-fat, and skim milk. Adapted from Pereira (2014)

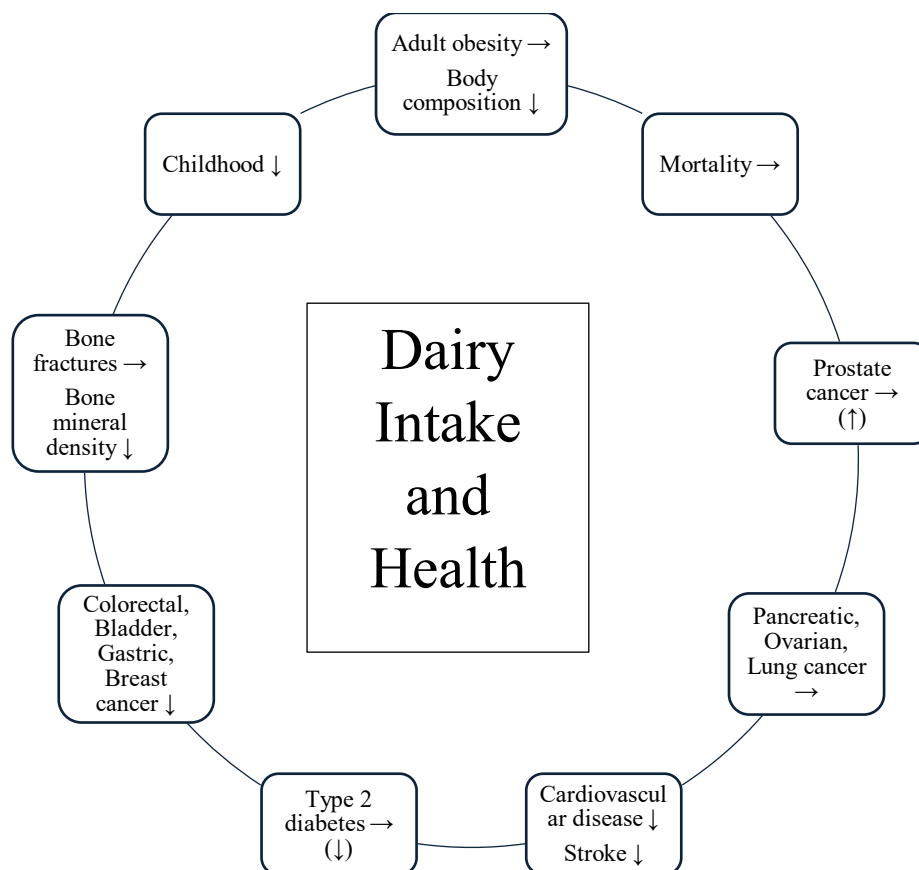
<b>Composition (100g)</b>	<b>Whole</b>	<b>Low-fat</b>	<b>Skim</b>
<b>Energy (kcal)</b>	62	47	34
<b>Water (g)</b>	88.1	89.1	90.5
<b>Protein (g)</b>	3	3.4	3.3
<b>Fat (g)</b>	3.5	1.6	0.2
<b>Carbohydrates (g)</b>	4.7	4.9	4.9
<b>Sodium – Na (mg)</b>	43	41	41
<b>Calcium – Ca (mg)</b>	109	112	114
<b>Magnesium – Mg (mg)</b>	9	9	10
<b>Vitamin A (mg)</b>	59	22	0
<b>Vitamin D (mg)</b>	0.05	0.05	0*
<b>Vitamin B<sub>1</sub> (mg)</b>	0.04	0.04	0.05
<b>Vitamin B<sub>2</sub> (mg)</b>	0.14	0.11	0.05
<b>Cholesterol (mg)</b>	13	8	1

\* If not fortified with vitamin D

Table 1 illustrates the nutritional composition of three commonly consumed milk types (Pereira, 2014). However, the composition of milk depends on the stage of lactation, age, breed, and health status of the udder (Haug et al., 2007). In addition to the above-mentioned nutrients, milk contains 4 mg/l zinc, 11 ug/l selenium in Nordic bovine milk and 37 ug/l selenium in the milk from USA, 0.6 mg/l vitamin E, 950 mg/l phosphorus (Haug et al., 2007; Pereira, 2014). Among the fat contents, saturated fatty acids (SFAs) make up 70% of the fat fraction, while unsaturated fatty acids make up 30% (Pereira, 2014). The sole unsaturated fatty acid in milk is oleic acid which is present in roughly 8 g of whole milk per liter (Haug et al., 2007). In skim milk and non-fat milk, vitamin D could be fortified as it is a fat-soluble vitamin and the removal of fat content also removes vitamin D from milk (Marangoni et al., 2019). Milk has both soluble and insoluble protein compounds and in addition to enhancing the absorption of other nutrients, milk proteins have biological activities that include antibacterial, antiviral, antifungal, antioxidant, antihypertensive, antimicrobial, antithrombotic, narcotic, and

immunomodulatory functions (Pereira, 2014). The amount of minerals is quite consistent and well established in milk but the quantity of vitamins present in milk and dairy products varies depending on a number of factors, including animal nutrition, biosynthesis, physicochemical conditions (heat, light, oxygen, oxidant agents), and analytical techniques used to measure the concentrations (Gaucheron, 2011). There are different country and region-specific dietary guidelines for milk and dairy consumption. According to the dietary guidelines of Nordic Nutrition Recommendations 2023, a daily intake of 350ml-500ml low-fat milk and dairy products should be enough to meet the dietary requirements of calcium, iodine and vitamin B12 if it is combined with enough intake of dark green vegetables, legumes and fish (Blomhoff et al., 2023).

Investigating the nutritional composition of dairy milk gives us more idea on the specific micronutrients and components that are related to human health outcomes. Thorning et al. (2016) have explored that consuming milk and dairy products helps people meet nutrient guidelines and may protect against the majority of chronic non-communicable diseases.



**Figure 1:** Association between dairy product intake and health effects. ↓ beneficial effect/association; ↑ adverse effect/association; → no effect/association. Sign in the parenthesis shows less scientific evidence. Adapted from Godos et al. (2020); Thorning et al. (2016); Zhang et al. (2021)

Following the review of scientific findings, it is observed that milk consumption is favorable to improve body condition and weight loss, lower incidence of childhood obesity, enhance bone mineral density (Marangoni et al., 2019; Thorning et al., 2016). Marangoni et al. (2019) have strengthened the association of milk intake with protective effects against obesity, overweight, type 2 diabetes and cardiovascular disease which are displayed in Figure 1. They argued that further studies are required to draw conclusions on the effect of milk consumption on cancer (Marangoni et al., 2019).

According to the review of the above studies and literature, a reasonable amount of milk and its derivatives could be advantageous for people of all ages, excluding certain

medical disorders like lactose intolerance or allergy to milk proteins (Marangoni et al., 2019; Thorning et al., 2016).

#### 2.1.4 Milk consumption and sustainability

Tricarico et al. (2020) have summarized that milk production should be done in a sustainable manner to ensure food security and climate change alleviation by improving human nutrition, health, and economic conditions for farmers in low-income countries. They also identified that the most significant and feasible way to enhance the sustainability of milk production and consumption in low-income nations is to increase milk production using the resources that are available. Salter (2017) has underlined several factors including population expansion, longer lifespan, and improved living standards in developing countries which are responsible for the growing demand of milk consumption. According to his review, this increasing demand for milk consumption could put pressure on animal feeding, land availability, and fresh water resources. Potential solutions to minimize the effects of high milk consumption could be for example, alternative husbandry techniques, practical and improved feeding practices of cattle, collection and sharing of animal records, innovation and matching of genotypes in animal breeding (Salter, 2017; Tricarico et al., 2020). Faye and Konuspayeva (2012) have presented in their article that non-cattle alternative milk like sheep, horse, donkey, camel, buffalo, and yak milk could be a solution to fight with the challenges of sustainability issues related to milk production and consumption. They also articulated that the majority of milk produced other than from cattle is produced in emerging or developing nations and instead of adapting western models, it is more convenient for them to capitalize on their available natural resources. Additionally, it will help them meet their nutritional needs, and it can act as an efficient way of fighting poverty by preserving the environment. However, Blomhoff et al. (2023) have stated that high consumption of milk and dairy products are responsible for greenhouse gas emissions in Nordic and Baltic countries. They also added that the feeding ingredients for dairy animals, like fertilizers, pesticides, water, and land use, mainly contribute to the inverse

environmental impact of methane emissions. In another study, Carlsson-Kanyama and González (2009) listed that from farm to table, per kg of milk with 4% fat is responsible for 0.45kg carbon dioxide, 0.14kg nitrous oxide, and 0.45kg methane emission.

From the perspective of developed nations, measures that could be implemented to combat the adverse effects of sustainable milk production and consumption include feeding management practices, well-organized dietary methane mitigating strategies, using ambient packaging, protecting milk containers during supply chain, rational use of fertilizers, and improved manure management practices (Burek et al., 2018; Krizsan et al., 2021).

## **2.2 Plant-based milk alternatives**

### **2.2.1 Processing and innovations of plant-based milk alternatives**

Sethi et al. (2016) have explored the emergence of various plant-based milk alternatives as newly developed beverages and how these products have slowly taken place in the consumer market in recent years. They have also elaborated on the technological processing of different types of plant-based milk alternatives and their respective health benefits. As stated by Sethi et al. (2016), “Plant-based milk alternatives are fluids that results from breakdown (size reduction) of plant material (cereals, pseudo-cereals, legumes oilseeds, nuts) extracted in water and further homogenisation of such fluids, results in particle size distribution in range of 5–20  $\mu\text{m}$  which imitates cow’s milk in appearance and consistency” (p.3409). Bocker and Silva (2022) have also supported this statement in their work that the soluble extract of plant matrices, including cereals, pseudo-cereals, seeds, vegetables, and nuts, is used to make plant-based milk alternatives. They have also discussed the general manufacturing process of plant-based milk alternatives, which includes peeling of the plant matrix, water addition, bleaching, wet grinding, filtering, addition of stabilizers, vitamins, and minerals, homogenization,

pasteurization, and finally the addition of colorings and flavors to produce plant-based milk alternatives.

Although, standard definition and classifications of plant-based milk alternatives are not found in any books or literature, depending on the source of plant matrix they can be classified into five categories: - cereal based: oat milk, rice milk, corn milk; legume based: soy milk, peanut milk, lupin milk, cowpea milk; nut based: almond milk, coconut milk, hazelnut milk, pistachio milk, walnut milk; seed based: sesame milk, flax milk, hemp milk, sunflower milk; pseudo-cereal based: quinoa milk, teff milk, amaranth milk (Sethi et al., 2016). Nevertheless, following the generic processing techniques stated by Bocker and Silva (2022), many new technologies and innovative methods have been involved in the production of plant-based milk alternatives. For example, precision fermentation and genetic engineering (Tachie et al., 2023), ultrasound, high-pressure processing, pulsed electric field, ultraviolet radiation, microwave, Ohmic heating, and supercritical carbon dioxide (Bocker & Silva, 2022). Additionally, some other conventional processing approaches like sprouting and germination, roasting, dehulling, extrusion, microfluidizer, high hydrostatic pressure, and cold atmospheric plasma could improve the organoleptic taste and quality of plant-based milk alternatives (Mehany et al., 2023).

**Table 2:** Consumption limitation and technological interventions for plant-based milk alternatives. Adapted from Sethi et al. (2016)

<b>Type of milk alternatives</b>	<b>Limiting factor in acceptance</b>	<b>Technological intervention to resolve the problem</b>
<b>Soy milk</b>	Beany flavor due to lipoxygenase action on unsaturated fatty acids	Vacuum treatment in high temperature, hot grinding, blanching in boiling water,
<b>Peanut milk</b>	Beany flavor	Roasting, alkali soaking, defatting, steaming

<b>Oat milk</b>	Presence of inhibitors phytates	Treatment with phytase in order to liberate inorganic phosphate from phytic acid
<b>Rice milk</b>	Poor emulsion stability due to high starch content	Enzymatic hydrolysis of starch by alpha and beta amylase or glucosidase
<b>Sesame milk</b>	Bitterness and chalkiness,	Roasting and alkali soaking have been observed to improve the overall acceptability and flavor

Table 2 demonstrates the consumption limitations of some widely available plant-based milk alternatives and the appropriate innovative technologies to fix them (Sethi et al., 2016). However, further research should be undertaken to invent more efficient and sustainable production practices to meet customer demand in the future (Bocker & Silva, 2022; Sethi et al., 2016).

### 2.2.2 Nutritional comparison of dairy milk and plant-based milk alternatives

The nutritional profile of cow milk has been discussed in a previous section and the review shows clear evidence that milk is considered one of the most perfect and balanced foods of nature, containing essential nutrients like carbohydrate, fat, protein, vitamins, and minerals. However, Vanga and Raghavan (2018) have highlighted that worldwide demand for plant-based milk alternatives is increasing as a result of concerns with lactose intolerance and milk protein allergies caused by cow's milk intake. Additionally, hypercholesterolemia and a growing tendency toward vegan diets have led customers to select alternatives to cow milk (Sethi et al., 2016). Nonetheless, customers are not always keen to agree that plant-based milk alternatives cannot be the direct replacement of cow milk in terms of nutritional quality and health benefits (Vanga & Raghavan, 2018). Depending on the different plant matrices used to produce plant-based milk alternatives, nutritional contents are also different.

**Table 3:** Comparison of nutritional components between commercially available selected plant-based milk alternatives and cow milk. Adapted from the data of Finnish Institute for Health and Welfare (THL) (n.d).

<b>Component Per 100g</b>	<b>Almond Drink, Sweetened, Alpro</b>	<b>Muksu Soy Drink</b>	<b>Oat Drink without Milk</b>	<b>Rice Drink, Rice Dream Hazelnut And Almond</b>	<b>Coconut Milk</b>	<b>Milk, Whole Milk, 3.5% Fat, Boiled</b>
<b>Energy calculated (kcal)</b>	24	72	41	81	209	66
<b>Carbohydrates (g)</b>	3	7.5	7.2	13.9	2.8	5
<b>Protein (g)</b>	0.5	2.5	1	1.3	2	3.1
<b>Fat (g)</b>	1	3.5	0.7	1.9	21.3	3.6
<b>Calcium (mg)</b>	120	105	5.4	7.1	18	129.2
<b>Iron (mg)</b>	0.1	1.3	0.3	0.5	3.3	<0.1
<b>Vitamin D (µg)</b>	0.8	1.3	0	0	0	1

Table 3 shows a comparative view of some selected plant-based milk alternatives and cow milk nutrient components. Data is taken from the ‘fineli – food items’ of Finnish Institute of Health and Welfare (THL). They have listed the nutritional information according to the respective product.

Existing studies have presented more insightful nutritional information on plant-based milk alternatives. Almond milk has gained popularity in the European Union, North America, and Australian markets as almond is a good source of vitamin E (Sethi et al., 2016) and monounsaturated fatty acids (MUFA) which is helpful to reduce weight (Vanga & Raghavan, 2018). It has been reported that soy milk was the first plant-based milk alternative used in China 2000 years ago and it is a rich source of protein (Sethi et al., 2016). However, almond allergy and soy allergy are the common adverse effects of these two types of plant-based milk alternatives (Vanga & Raghavan, 2018). Bocker and

Silva (2022) have mentioned in their study that oat milk could be a good source of high carbohydrate, lipid, fiber, but no allergenic potential has been found. The disadvantages of oat milk included by them are its low calcium content and the presence of antinutrients. Rice milk has the same advantages as oat milk: high carbohydrate content, no allergenic potential and being a good source of magnesium, phosphorus, potassium, and vitamin B and E (Bocker & Silva, 2022). In contrast, research indicates that improper consumption of rice milk, particularly in infants, can lead to malnutrition due to the varied nutrient profile, resulting in protein-energy malnutrition (Kwashiorkor) (Vanga & Raghavan, 2018). Coconut milk is a unique type of milk alternative, having less calorie content, and availability of magnesium, iron, copper ions (Bocker & Silva, 2022). On the other hand, coconut milk is rich in saturated fatty acids and low content of monounsaturated and polyunsaturated fatty acids (Vanga & Raghavan, 2018).

Research conducted in different countries comparing the nutritional composition of cow milk and plant-based milk alternatives has clear suggestions and implications for their own perspectives. A recent cross-sectional study conducted by Brooker et al. (2023) has shown that, dairy milk and plant-based milk substitutes available in Australia have generally lower carbohydrate content but higher calorie, protein, and fat contents than those in Singapore, but the calcium content in those products was similar. In another study conducted in the UK, Clegg et al. (2021) have found that the price of plant-based milk alternatives is three times higher than the dairy milk. They also suggested that plant-based alternatives with high fiber content could be used as a temporary replacement but not as a direct replacement of dairy milk, which has more carbohydrate, protein, saturated fat, energy, vitamin B<sub>12</sub>, and B<sub>2</sub>. This opinion is also supported by Chalupa-Krebzdak et al. (2018) that public decisions should be based on the nutritional education available on the products. Therefore, it is safe to recommend that cow milk is still a better source of fat, protein, calcium, and other micronutrients than plant-based milk alternatives (Collard & McCormick, 2021).

### 2.2.3 Challenges and opportunities of plant-based milk alternatives

Plant-based milk alternatives have started to attain public familiarity during the last decade, and this can be attributed to a number of factors, including rising consumer consciousness, high demand for vegan products, and extensive efforts to promote and embrace sustainable practices with ethical concern (Tachie et al., 2023). Initially, it was appreciated that these plant-based alternatives could provide an alternative solution where dairy milk supply is limited and a potential cheaper option for middle class people living in developing countries (Sethi et al., 2016). However, several studies have shown that the price is higher for plant-based milk alternatives than dairy milk, and the difference is substantial (Clegg et al., 2021). Regardless of the price difference, plant-based milk alternatives do not contain the same nutritional composition as discussed in the previous section. Chalupa-Krebzdak et al. (2018) have expressed in their article that replacing cow milk with these plant-based alternatives would not have a positive outcome if the diet is not supplemented properly to compensate for the deficiencies. They also added that the main catalyst that gives customers the courage to replace bovine milk could be that plant-based alternatives are branded as ‘milk’ in their labeling.

Despite the nutritional deficiencies compared with cow milk, research has shown evidence that plant-based alternatives have been a good substitute for people having difficulties with the consumption of dairy milk, like lactose intolerance and cow milk protein allergy (Silva et al., 2020). Vanga and Raghavan (2018) have commented that lactose intolerance is one of the main causes of the rise in demand for plant-based replacement milks. New technologies have been introduced in the processing of plant-based milk alternatives to give the best possible taste and to ensure proper nutritional quality for the customers (Paul et al., 2020). However, most of these thermal processing technologies are questioned on their sustainability, and non-thermal processing techniques are now prioritized (Mehany et al., 2023). Reyes-Jurado et al. (2023) have examined the potential challenges associated with the processing and fortification of plant-based milk alternatives. According to their study, the major challenges to establishing plant-based milk alternatives as a good alternative to cow milk would be improving taste, reducing antinutrients and allergens, and enhancing the stability of the shelf life.

## **2.3 Factors associated with consumption of milk and plant-based milk alternatives**

### **2.3.1 Factors associated with milk consumption**

Researchers have tried to determine the underlying factors responsible for the consumption of milk from different perspectives. Kapaj and Deci (2017) have explained that women are more encouraged to consume milk than men, and the household composition of young children aged twelve or less might lead to more consumption of milk regardless of the price. Additionally, higher-income consumers were more inclined to buy milk products, while consumers with higher education were more likely to eat dairy products than those with less education. They have also added that the amount of dairy products consumed in a home has been found to be highly impacted by consumers' health consciousness. A study was conducted in Malaysia, and it found that dairy product consumption is higher among consumers who believe that dairy products are an excellent source of nutrients than among other consumers (Boniface & Umberger, 2012). In another research done by Kurajdová et al. (2015) in Slovakia, it was explained that, compared to other nations in the European Union and the rest of the world, Slovak consumers eat very little dairy products, which has a detrimental effect on companies in this industry. This low consumption of milk was because the majority of consumers reported dissatisfaction with the taste of milk, and it was recommended by Kurajdová et al. (2015) to the marketing managers to enhance the product information during marketing campaigns to highlight the positive health effects and practical utilization of milk for every household. This low milk consumption trend was found in United States also where decreased dairy product consumption led to low intake of potassium (McGill et al., 2008).

Kapaj and Deci (2017) have identified that consumers make their decisions on the quality of dairy products on four factors and these are taste or smell, health related, convenience of the places to buy milk, and process of milk. Roustae et al. (2024) have also stated in their article that overall dairy product consumption is higher in urban areas of Iran, and it could be because of the convenience of milk purchase. Another interesting review made

by Ahmad et al. (2023) shows that milk consumption is also related to environmental and personal issues. Therefore, the summary of milk consumption factors could be socioeconomic and demographic factors such as income, education, gender, age, ethnicity, knowledge level, the number of young children in the household, and environmental factors, each of which has a specific impact on households' consumption and expenditures for dairy products and milk (Kapaj & Deci, 2017).

### 2.3.2 Factors associated with plant-based milk alternatives consumption

Plant-based milk alternative consumption is also related to some interesting factors like milk consumption, and research has been ongoing to identify them. As discussed in the previous sections, milk consumption is decreasing in developed nations, and customers are now more interested in non-dairy milk alternatives than fluid milk due to sweet and creamy attributes or sugar level, plant source preference, package size, smooth and nutty flavor (McCarthy et al., 2017; Moss et al., 2022). In another comparative study, Haas et al. (2019) showed that digestibility and allergy-free characteristics are two key factors for customers to choose plant-based milk alternatives. They also added that the motivational factors that could drive consumers toward plant-based milk alternatives are animal welfare and a sustainable food diet. Moreover, a strong desire to consume fewer animal foods, opinions regarding the abuse of animals, and the idea that plant-based foods have lower environmental impact than dairy milk are inspiring plant-based alternative milk consumers (Boaitey & Minegishi, 2020; McCarthy et al., 2017). Due to some adverse effects of dairy milk consumption, like lactose intolerance and milk protein allergy, plant-based alternative milks are also recommended for the dietary management of those specific consumers (Katoch et al., 2022).

Along with the persuading factors, there are also barriers and perceptions that could affect the decisions of plant-based customers. For example, off-flavor, beany, brown, and watery aftertaste might be detracting factors for the consumers and could create negative image for the plant-based milk alternatives (Moss et al., 2022). The negative sensory attribute of plant-based milk alternatives is also supported by Giacalone et al. (2022) in

their study, which found that dairy products have distinct flavor and texture characteristics that are difficult to imitate in plant-based milk substitutes. However, the majority of these studies have highlighted the need for more investigation and further research on different plant-based milk substitutes, the different ingredients used in them, and how they relate to consumer preferences in the future (Alae-Carew et al., 2022; Giacalone et al., 2022; Moss et al., 2022).

## **2.4 Highlights of emerging issues and the value of the research work**

A considerable amount of literature has been published on the nutritional composition of dairy milk and its health benefits and impacts on various chronic diseases like stroke, cancer, cardiovascular disease, and type 2 diabetes. Studies on region and continent specific milk consumption trends were available, and it has been found that consumption trends are increasing in developing countries but decreasing in developed countries (Gerosa & Skoet, 2012; Kumar et al., 2014). However, there are relatively few studies that have shown the underlying reasons for low milk consumption in developed countries, and this is also applicable to Finland. Potential reasons for low milk consumption could be a dietary shift towards plant-based milk alternatives due to high income, education, occupation, family size, age, and gender. Aforementioned socioeconomic factors were considered in some studies, but no research was done on longer term consumption data on milk and plant-based milk alternatives. Although, majority of the studies followed questionnaire data collection techniques, it could be possible to increase the accuracy of the purchase or consumption trend by collecting automatically accumulated customer data. There could be longer term variation or seasonal changes in patterns over the year for milk and plant-based milk alternatives consumption. Some studies have claimed that the adverse health effects of dairy milk digestion, like lactose intolerance or milk protein allergy could be the major reason for this dietary change among conscious consumers in rich countries (Katoch et al., 2022). Therefore, it could be possible that customers' knowledge of plant-based items and their educational status might play an important role in shifting from dairy items to plant-based items. However, almost all the articles reviewed on the nutritional comparison of milk

and plant-based milk alternatives recommended that plant-based items should not be used as a direct replacement for dairy milk.

This review of literature stressed the need for the identification of longitudinal consumer patterns or consumption trends of milk and plant-based milk alternatives. Moreover, from the viewpoint of a public health researcher, it would be interesting to explore the changes in patterns and potential sociodemographic factors behind this trend to provide valuable information for people related to the milk and plant-based item industries. This research can influence health professionals to recommend better dietary guidelines and a healthy lifestyle.

### **3. AIMS/RESEARCH QUESTIONS**

The general aim of this study was to explore the patterns of different milk purchases and plant-based milk alternatives and how they are associated with the sociodemographic conditions of the customers. The research questions were as stated below.

1. What are the purchasing patterns of liquid milk products and do they change over time?
2. What are the purchasing patterns of plant-based milk alternatives and do they change over time?
3. How do demographic and socioeconomic factors correlate with the purchase patterns of milk and plant-based milk alternatives?

## **4. MATERIALS AND METHODS**

### **4.1 Study design and participation**

Data used in this study were obtained as LoCard grocery purchase data from S Group, which is the largest commercial grocery retailer in Finland with a market share of 46% in 2018 (Finnish Grocery Trade Association, 2019). Approximately 2.4 million households are covered by S-group, which means that 88% of Finnish households have purchasing records in their databases (Vuorinen et al., 2020). Customers who sign up for S Group's loyalty card program receive an electronic customer card to use at checkout. In exchange for their purchases, customers can earn up to a 5% financial bonus, which is repaid to them each month. Only purchases made with the primary cardholder in the household were used in this study.

Household's primary cardholders in Finland who are part of the S Group loyalty card program were contacted by email with an invitation to participate in the study. This involved voluntarily answering the study questionnaire and granting permission for their grocery purchase data from September 1st, 2016 to December 31st, 2018 to be released for research purposes. Excluded were members who had not disclosed their email address or who had forbidden the retailer to send them any materials referring to marketing or research. Additionally, cardholders under 18 years of age were also excluded. S Group sent out all the invitations as they possessed the contact details of their customers.

This study used different types of liquid milk and plant-based drink purchase data from September 1st, 2016 to December 31st, 2018. The item description, time stamp, quantity (i.e. weight, volume) and price for all items were included in the data. Approximately 2.4 million primary loyalty card holders in S Group were evaluated for eligibility. Almost half (1,214,663, 51%) of the loyalty card holders were contacted and of these 47,066 (4%) consented to participate. The quantity of valid email addresses and the number of emails that reached the cardholders were unknown (for example, by getting past spam email filters). From the consented participants, 36,621 (78%) responded to the background questionnaire, and among them, 23,215 (63%) had at least 61% loyalty to be

included in the study. Participant recruitment and eligibility flow chart is shown in Figure 2.

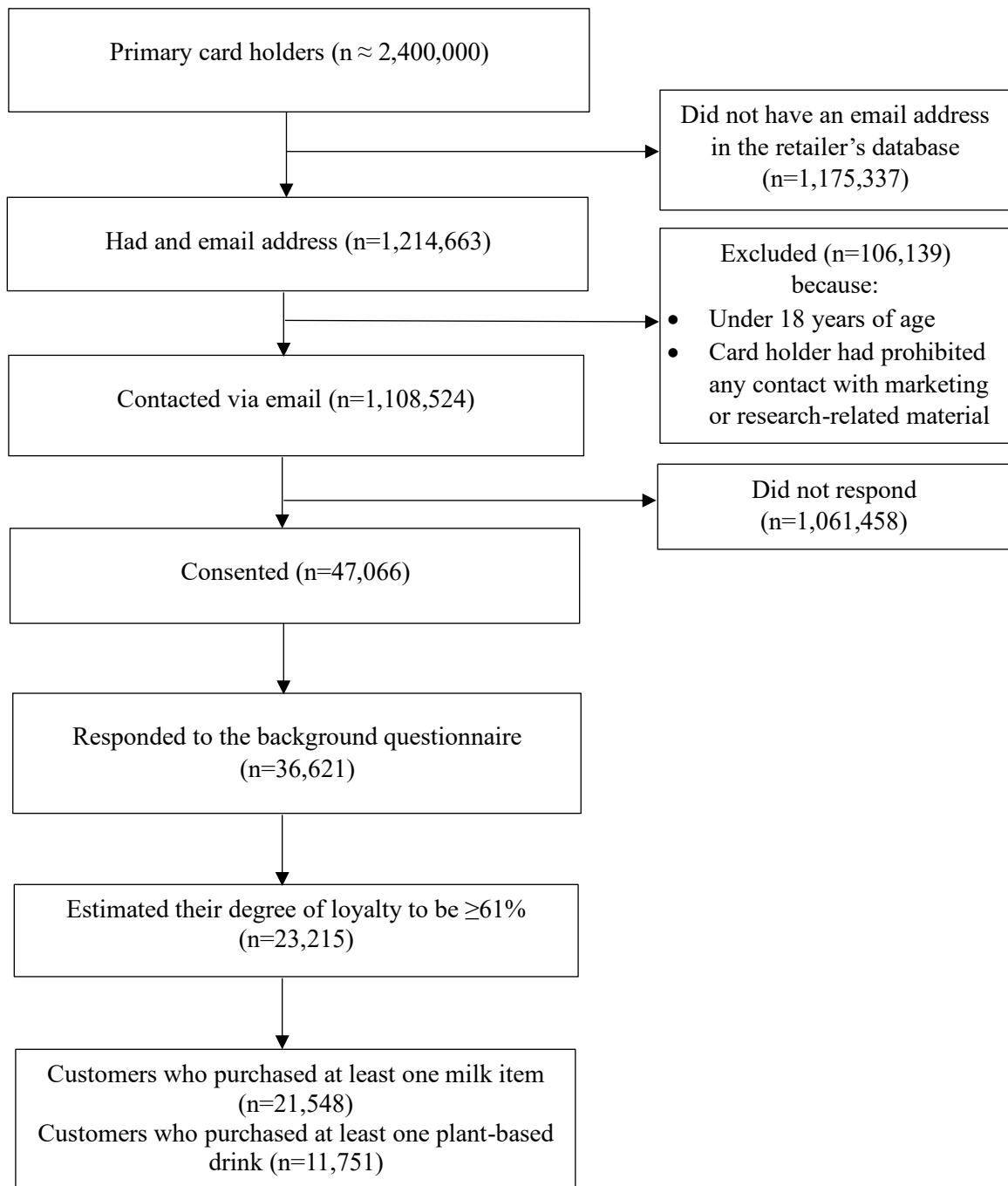


Figure 2: Participant recruitment and eligibility flow chart. Adapted from Vuorinen et al. (2020)

## 4.2 Variables

### Sociodemographic and background variables

All consenting participants were requested to fill out the online background questionnaire which included the following sociodemographic variables: education, marital status, size of the household, occupational status, and income. Information on participant age and sex was added to the background data using the retailer's electronic database. Age was a continuous explanatory variable. Sex was coded as male (0) and female (1). In the background questionnaire, participant customers also reported their degree of loyalty. There were five categories for loyalty: 1)  $\leq 20\%$ , 2) 21 – 40%, 3) 41 – 60%, 4) 61 – 80%, and 5)  $> 80\%$ . This study only utilized customer data with at least 61% degree of loyalty. To report the education status, customers were asked about their level of education and the categories were 1) primary school, 2) upper secondary school, 3) bachelor's degree or equivalent, 4) master's degree or higher, and 999) something else. Marital status was reported as 1) married or registered partner, 2) cohabitating, 3) divorced or separated, 4) widow, and 5) single. The number of household members or family size variable was treated as continuous variable. Occupational status was categorized as 1) employed, 2) partly employed and partly retired, 3) temporarily unemployed, 4) unemployed, 5) student, 6) parental and maternity leave, 7) long term sick leave, 8) retired, 9) not working for other reasons, and 999) other. Household's income per month was reported as 1)  $< 1500$  euro, 2) 1500 – 2999 euro, 3) 3000 – 4499 euro, 4) 4500 – 5999 euro, 5) 6000 – 7499 euro, 6) 7500 – 8999 euro, 7)  $\geq 9000$  euro, and 8) I don't want to tell.

From the above mentioned socioeconomic and background variables, age and family size were transformed from continuous variables into categorical variables. Age was divided into four categories as 1) 18 – 29, 2) 30 – 44, 3) 45 – 59, and 4) 60 or more. Family members were categorized as 1) 1 member, 2) 2 members, 3) 3 three members, and 4) 4 or more members. Households' income was recategorized into five categories as 1)  $< 1500$  euro, 2) 1500 – 2999 euro, 3) 3000 – 4499 euro, 4) 4500 – 5999 euro, and 5) 6000 euro or more.

## **Dependent variables**

### Milk and plant-based drinks

Milk and plant-based drinks purchasing data collection was done electronically during the use of loyalty card at the checkout for each purchase. Each purchase was associated with the volume measured in kilograms (kg), and a timestamp (the year and month for that specific purchase were noted accordingly in the data). Four index variables (class 1 – class 4) were used to classify different types of milk purchases and plant-based drinks (Kanerva et al., 2023). Class 2 index variable was used to identify either liquid milk products or plant-based drinks. Class 4 index variable was used to identify six types of milk products: semi skimmed milk, skimmed milk, whole milk, other milks, other sour milks, and semi skimmed sour milk. Plant-based drinks were similarly indexed in all four classes of index variables. Purchased milks or plant-based drinks were identified by the index variables, and the respective volume in kilograms was used in the data as the main dependent variable with scale measurement. Additionally, timestamp data as month and year from 9-2016 to 12-2018 was transformed into a new time variable as 9-2016 -> time 1, 10-2016 -> time 2... 12-2018 -> time 28. In total, we had 28 time points as the repeated measurement to check the purchase patterns for sex, categorized age, and education. For each time point or for each month, the total volume of liquid milk and plant-based drinks was aggregated to represent the monthly liquid milk purchase or monthly plant-based drinks purchase. This variable was named “volume” and this was our principle dependent variable to check the purchase patterns and how they are associated with the three selected sociodemographic factors for further analysis.

### **4.3 Statistical methods**

Data was aggregated and restructured to fulfill the purpose of this research. First, data was restructured from long format into wide format to calculate general characteristics of the participating loyalty cardholders. Frequencies and percentages were used to describe the distribution. All the information related to the background and

socioeconomic variables were collected at a single point of time. Although the purchasing data for liquid milk and plant-based drinks represented real longitudinal variation, sociodemographic factors like age, income, and education were the same for the whole 28 month' time period in the dataset. Participants who did not want to disclose their educational status, income level, or number of family members were excluded from any further analysis along with the missing values. After the exclusion, 21,668 participants had all the information related to our selected sociodemographic variables and their respective purchase data over the whole calendar period of 28 months (September 2016 to December 2018). Second, purchasing data was aggregated for each month from month 1 to month 28 for all liquid milk types and plant-based drinks to check the participants purchasing trends. If there was no purchase for liquid milk or plant-based drinks for a specific month, the following available month was listed and counted. Third, average purchasing trends for the whole 28 month' time period were listed across different sociodemographic variables and categories. Visualizations of the associations were reported by relevant graphs at the end of the analysis process.

### **Linear mixed effects model specification**

The final research objective of this study was to analyze the associations between sex, categorized age, and education categories with purchasing trends of liquid milk and plant-based drinks. The linear mixed effects model (LMM) was used to check the association between the selected sociodemographic variables (sex, age, and education) and the monthly purchasing trends by accounting the fixed effects and 28 months' time as a repeated measure. The models were run separately for each sociodemographic factor with time variable as repeated measures. The linear mixed effects model (LMM) was applied because of its capacity to handle data with hierarchical structure which means there were repeated purchases for all individuals, and to account for both within-group and between-group variability (Heck et al., 2022). To analyze the data by this model, IBM SPSS Statistics software (version 29.0.0) was used. Before conducting the analysis, data was cleaned from missing values and a time variable for 28 months was created as a repeated covariance type.

Restricted maximum likelihood estimation (REML) was used to fit the linear mixed effects model and produce unbiased estimates of the variance components (Heck et al., 2022). Hypotheses were tested using Wald Z-tests for fixed effects and the significance level was set at  $\alpha = 0.05$  and p values below 0.05 were considered statistically significant. After the model analysis, results were reported according to the guidelines for mixed models as estimated coefficients (B), 95% confidence intervals (CI), and p-values for each fixed effect. This careful use of LMM in SPSS made sure that the complicated structure of our data was properly accounted for in the analysis, yielding dependable and understandable results.

#### **4.4 Ethical aspects**

The study was approved by the University of Helsinki Review Board in the Humanities and Social and Behavioral Sciences (Statement 21/2018). All the participant customers provided their informed consent electronically, when they were invited via email to release their loyalty card data and fill out the background questionnaire. Before the researchers could access the data, S Group pseudonymized the data which is a de-identification procedure in which personal identification codes were replaced by pseudonyms.

## **5. RESULTS**

### **5.1 Characteristics of the participating loyalty cardholders**

The characteristics of the participating loyalty cardholders are shown in Table 4. Out of the overall participants (N=23,215), one third were males (33.9%) and two thirds were females (66.1%). Age group 30-44 had the highest percentages (32.6%) followed by 45-59 (28.4%), and the lowest was for age group 18-29 (12.4%). Upper secondary school (37.7%) was the most common educational attainment, followed by bachelor's degree (31.9%), and master's degree or above (23.5%). The income distribution was quite fairly distributed across the various income groups, with 23.8% earning between 3000-4499 euros and another 23.8% making 6000 euros or above, and 1407 participants did not want to disclose their income status or were missing in the dataset. Among the family size categories, two member families dominated the percentages (39.7%), and the lowest was for three member families (13.5%).

**Table 4:** Characteristics of the participating loyalty cardholders

Variables	Total N = 23,215	
	n	%
<b>Sex</b>		
Male	7879	33.9
Female	15336	66.1
<b>Age</b>		
18-29	2869	12.4
30-44	7579	32.6
45-59	6586	28.4
60 -	6181	26.6
<b>Education</b>		
Primary school	1531	6.6
Upper secondary school	8759	37.7
Bachelor's degree or equivalent	7414	31.9
Master's degree or higher	5457	23.5
Missing or other	54	0.23
<b>Income</b>		
< 1500 euro	1934	8.3
1500 – 2999 euro	4837	20.8
3000 – 4499 euro	5535	23.8
4500 – 5999 euro	3978	17.1
6000 or more	5524	23.8
Missing	1407	6.1
<b>Family size</b>		
1 member	5806	25
2 members	9207	39.7
3 members	3139	13.5
4 or more members	4959	21.4
Missing	104	0.4

## 5.2 Purchasing trends of different types of milks and plant-based drinks

Figure 3 displays the purchasing trends of six different types of liquid milks and plant-based drinks over a two-year period, from September 2016 to December 2018. The months within the given time frame are indicated on the x-axis, while the total purchase volume in kilograms (kg) is represented on the y-axis. The lines are indicated by a different color for each, stand for various milk and plant-based drink types. The purchase volume is dominated by semi skim milk (blue line) and skimmed milk (black line), with values ranging from 80,000 kg to over 100,000 kg. Over the course of the period, the biggest purchase volumes are for these two varieties of milk compared with other types. Although semi skim and skimmed milk are the most purchased types, the trend is decreasing for skimmed milk. However, plant-based drinks show an increase in purchase volume over the same period. Other types of milk, including semi skimmed sour milk, other sour milks, and other milks show a fluctuating trend in purchase volume over the two-year period. Moreover, there seems to be a seasonal trend in the purchase volume of whole milk as purchase volume appears to be higher in the winter (December).

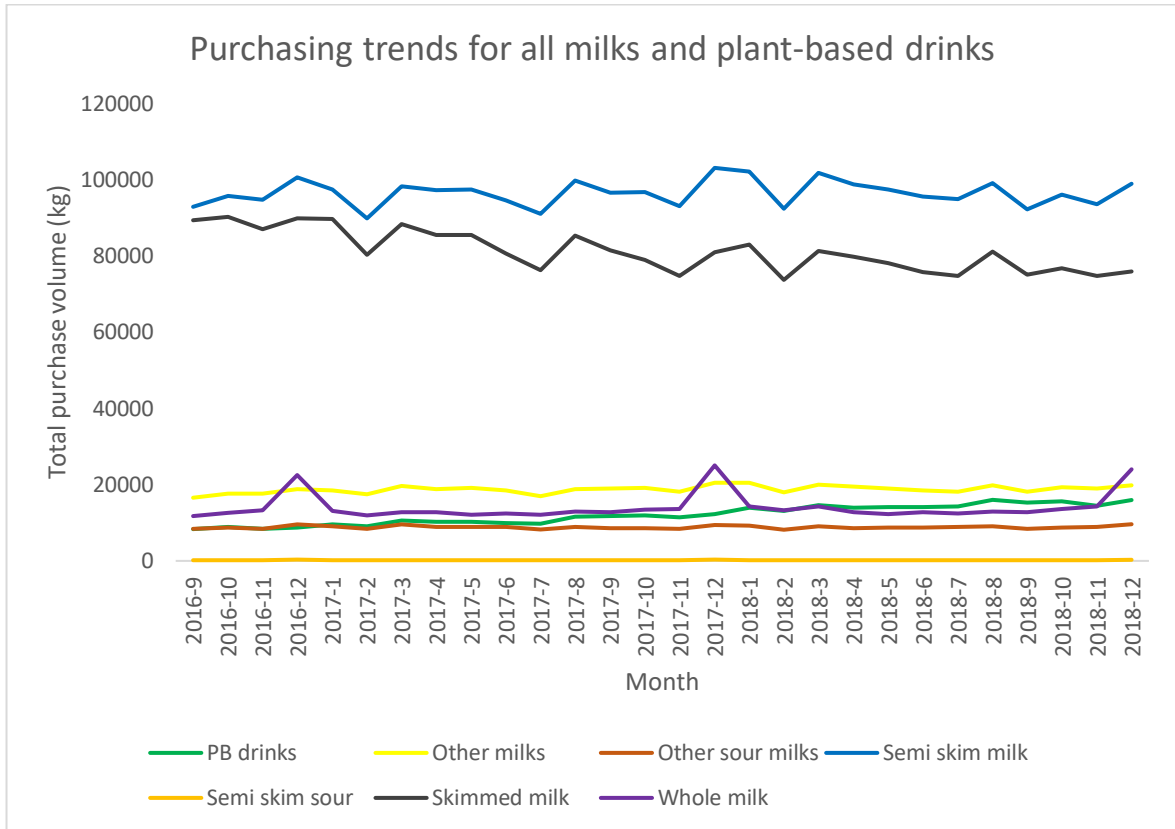
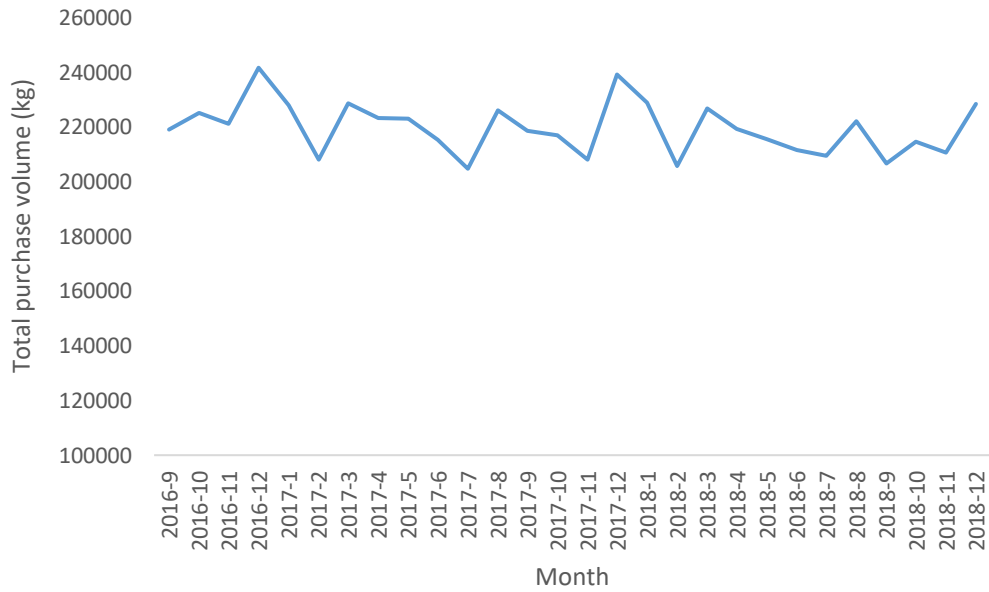


Figure 3: Purchasing trends for different types of milks and plant-based drinks

Additionally, we used Class 2 classification which combines all the liquid milk products together as liquid milk and plant-based drinks as shown in Figure 4. The blue line shows the purchasing trend for liquid milk products, and the green line shows plant-based drinks. Over the course of the 28 months, there seems to have been a slight decreasing tendency in the overall volume of liquid milk product purchases. On the other hand, plant-based drinks show a gradual increase in purchase volume during the same time period. Actual volume numbers to make these purchasing trend graphs are added in the appendices section (appendix 1) for milk products and plant-based drinks for specific months.

Purchasing trend for liquid milk products



Purchasing trend for plant-based drinks

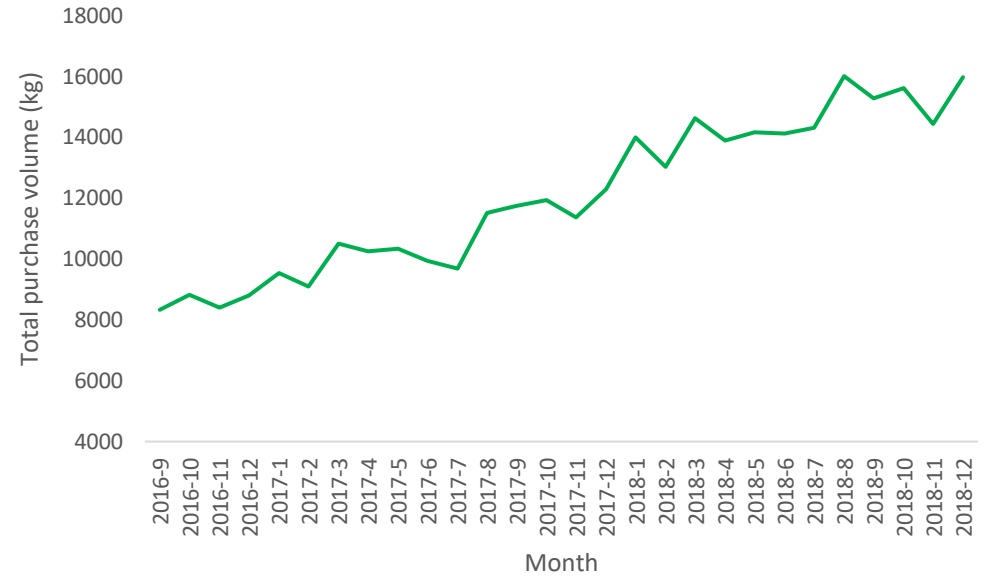


Figure 4: Purchasing trends for liquid milk and plant-based drinks (Y axis does not start from 0 to illustrate specific purchasing patterns in detail)

### **5.3 Sociodemographic factors associated with liquid milk and plant-based drinks purchase patterns**

#### Average purchasing characteristics for different sociodemographic factors

Table 5 shows the overall distribution of the mean (standard deviation) purchase volume in kilograms (kg) for liquid milk and plant-based drinks across different sociodemographic factors. On average, females purchase slightly less liquid milk (281.56 kg) than males (292.56 kg) over the time of 28 months. Purchasing pattern is also higher for males in plant-based drinks (30.41 kg) than females (28.12 kg). Participating customers aged between 45-59 and 30-44 years old have the highest average purchase volume of liquid milk (333.05 kg, and 330.83 kg), and the lowest average purchase is for those aged 18-29 years old (136.98 kg). Average plant-based drinks purchase is higher among participants aged 30-44 (36.59 kg) and least is for participants aged 60 or more (19.87 kg). Cardholders having education status of upper secondary school purchase the most liquid milk (297.12 kg) on average, followed by those with a primary school education (295.18 kg) and the least for master's degree or higher (272.20 kg). Average plant-based purchasing patterns show opposite scenario as participants with a master's degree or higher education purchase the most plant-based drinks (34.97 kg) on average, followed by those with a bachelor's degree (28.13 kg), and the minimum for primary school education (24.27 kg). Participants with the lowest income level (< 1500 euro) purchase the least amount of liquid milk (183.09 kg) on average, and those who are in the highest income level (6000 euro or more) purchase the most liquid milk (321.86 kg) on average. However, the difference between different income levels for average plant-based drinks purchase patterns is small. As anticipated, families with more members tend to buy more plant-based drinks and liquid milk. On average, families with four or more members purchase the most liquid milk (507.68 kg) and plant-based drinks (39.74 kg), while families with only one member purchase the least amount of liquid milk (159.84 kg) and second lowest for plant-based drinks (25.12 kg).

**Table 5:** Distribution of sociodemographic factors and mean (standard deviation) of participants total purchase of liquid milk and plant-based drinks during the whole calendar time (9-2016 to 12-2018).

<b>Sociodemographic factors</b>	<b>Average liquid milk purchased volume-kg* (STD)</b>	<b>Average plant-based drinks purchased volume-kg* (STD)</b>
<b>Sex</b>		
Male	292.56 (324.20)	30.41 (71.67)
Female	281.56 (329.94)	28.12 (63.70)
<b>Age</b>		
18-29	136.98 (174.56)	25.18 (47.03)
30-44	330.83 (366.37)	36.59 (81.10)
45-59	333.05 (360.41)	26.71 (63.06)
60-	247.27 (264.44)	19.87 (47.73)
<b>Education</b>		
Primary school	295.18 (327.16)	24.27 (64.23)
Upper secondary school	297.12 (348.12)	25.12 (61.02)
Bachelor's degree or equivalent	279.43 (321.05)	28.13 (60.72)
Master's degree or higher	272.20 (303.38)	34.97 (77.44)
<b>Income</b>		
< 1500 euro	183.09 (238.65)	29.25 (58.77)
1500 – 2999 euro	243.15 (300.67)	30.22 (66.76)
3000 – 4499 euro	298.24 (342.84)	27.32 (66.07)
4500 – 5999 euro	316.08 (332.72)	27.01 (64.26)
6000 or more	321.86 (346.91)	30.02 (68.71)
<b>Family size</b>		
1 member	159.84 (187.79)	25.12 (50.82)
2 members	226.31 (243.84)	24.35 (51.76)
3 members	338.35 (318.88)	28.42 (60.60)
4 or more members	507.68 (456.67)	39.74 (95.54)

\* Average purchase for the whole 28 months of calendar time period (from 9-2016 to 12-2018)

Linear mixed effects model (LMM) to analyze the association between sociodemographic factors (sex, age groups, and education) and purchasing trends of liquid milk products and plant-based drinks

The linear mixed effects model results indicate the three selected sociodemographic factors (sex, age, and education) and their influence on the purchasing volume of liquid milk products and plant-based drinks. The results are summarized in Table 6. The beta coefficient for time is negative (beta = -0.028, CI = -0.033, - 0.024) and is statistically significant (p value < 0.001) for liquid milk products, which means that purchasing trend for liquid milk products decreases over time. On the other hand, beta coefficient for time is positive (beta = 0.011, CI = 0.007, 0.015) and is statistically significant (p value < 0.001) for plant-based drinks meaning that purchasing trend for plant-based drinks increases over these 28 months time period.

Males are predicted to purchase more of both liquid milk products and plant-based drinks than females. Beta coefficients for males in liquid milk products is 0.683 (CI = 0.520, 0.846) and for plant-based drinks 0.800 (CI = 0.651, 0.948), both are statistically significant (p value < 0.001). This suggests that the predicted volume is 0.683 kg higher for liquid milk products and is 0.800 kg higher for plant-based drinks in males compared to females, when month is 0. But the interaction of time with sex coefficients was not significant (p-value 0.998 for milk and 0.833 for plant-based drinks), meaning that the decreasing trend in milk purchases did not differ between males and females.

The estimate for the first age group 18-29, the beta coefficient is -3.721 (CI = -4.003, -3.438). This means that the average purchased volume for the first age group is predicted to be 3.721 kg lower than the intercept or the reference category of age group 60 or more. Additionally, the time interaction for age group 18-29 is also statistically significant (p value 0.046) and beta is 0.017 (CI 0.000, 0.034), meaning that the purchasing volume for liquid milk has slightly increased over time for them compared with the reference age group. For age group 30-44 (Beta = 3.240, CI = 3.042, 3.437) and for 45-59 (Beta = 3.807, CI 3.604, 4.011), beta values are positive which means that the purchasing trends are 3.240 kg or 3.807 kg higher

compared to age group 60 or more. However, time interaction for age group 45-59 is significant ( $p$  value  $< 0.001$ ) and the beta value is  $-0.047$  (CI  $-0.060, -0.035$ ). This means that the liquid milk purchasing volume decreased slightly over time for this age group. The beta value for main effect of time is negative ( $-0.017$ ) and it is statistically significant ( $P < 0.001$ ) meaning that the overall purchased liquid milk volume decreased over time. The values for plant-based drinks purchasing trends for age group 18-29 has a negative beta coefficient (Beta =  $-0.255$ , CI =  $-0.480, -0.030$ ), which is statistically significant ( $p$  value =  $0.026$ ). Similarly, like liquid milk trends, positive beta coefficients are indicating an increase in purchased plant-based drinks volume in kg for age group 30-44 (Beta =  $1.036$ , CI =  $0.851, 1.221$ ) and for age group 45-59 (Beta =  $0.592$ , CI =  $0.391, 0.793$ ), and both are statistically significant ( $p$  values  $< 0.001$ ). The beta for main effect of time is  $0.012$  ( $p < 0.001$ ) meaning that the plant-based volume purchase increased over time. The interaction between categorized age and time is not statistically significant for plant-based drinks. This indicates that for all age groups, the effect of time on purchased volume is the same and the purchase volume increases with age and time, but this increase is not affected by age.

The beta coefficient estimates for the first three education levels are positive when compared with the master's degree education group (primary school, Beta =  $0.780$ ; upper secondary school, Beta =  $1.141$ ; bachelor's degree or equivalent, Beta =  $0.284$ ), and these are statistically significant ( $p$  values  $< 0.001$  and  $p = 0.008$ ). The main effect of time is also not different (beta =  $-0.028$ ,  $p < 0.001$ ) for liquid milk. No statistical significance has been found for the education and time interaction for liquid milk purchasing trends ( $p$  values  $> 0.05$ ). Then, for plant-based drinks, primary school education group has the positive beta coefficient (Beta =  $0.266$ ) compared with the reference master's degree group, but this is not statistically significant ( $p$  value =  $0.151$ ). However, with the interaction of time with customers having primary school education, beta is negative ( $-0.024$ , CI  $-0.044, -0.003$ ) and this is statistically significant ( $p < 0.023$ ) suggesting that the interaction is mainly attributable for the difference in trends between individuals with primary school education and individuals with master's degree. Other two education groups show negative beta coefficient (upper secondary school, Beta =  $-0.280$ ; bachelor's degree, Beta =  $-0.351$ ) compared with

master's degree and these effects are statistically significant ( $p$  values  $< 0.001$ ). The slopes for interaction of time and other two educational groups (upper secondary and bachelor's degree) are also negative but not statistically significant ( $p$  values  $> 0.05$ ). The main effect of time for educational categories with plant-based purchasing volume is positive (beta 0.016) and it is statistically significant ( $p < 0.001$ ).

Line graphs are shown in Figures 5, 6, and 7 with a specific line for each category as a comparison of liquid milk products and plant-based drinks purchasing trends.

**Table 6:** Fixed effects beta ( $\beta$ ), 95% confidence intervals (CI) and p values for different sociodemographic factors and purchase patterns by linear mixed effects models\*.

Factors with reference category	Liquid milk products <sup>b</sup>			Plant based drinks <sup>b</sup>		
	Beta	95% CI	p-value <sup>c</sup>	Beta	95% CI	p-value <sup>c</sup>
<b>Time<sup>a</sup></b>	-0.028	-0.033, -0.024	< 0.001	0.011	0.007, 0.015	< 0.001
<b>Sex (ref = female)</b>						
Time	-0.028	-0.034, -0.023	< 0.001	0.011	0.006, 0.015	< 0.001
Male	0.683	0.520, 0.846	< 0.001	0.800	0.651, 0.948	< 0.001
Sex x time	-1.444×10 <sup>-5</sup>	-0.010, 0.010	0.998	-0.001	-0.009, 0.007	0.833
<b>Age (ref = 60 -)</b>						
Time	-0.017	-0.026, -0.008	< 0.001	0.012	0.003, 0.020	0.010
18-29	-3.721	-4.003, -3.438	< 0.001	-0.255	-0.480, -0.030	0.026
30-44	3.240	3.042, 3.437	< 0.001	1.036	0.851, 1.221	< 0.001
45-59	3.807	3.604, 4.011	< 0.001	0.592	0.391, 0.793	< 0.001
18-29 x time	0.017	0.000, 0.034	0.046	0.011	-0.002, 0.023	0.090
30-44 x time	0.009	-0.003, 0.021	0.136	0.002	-0.008, 0.013	0.676
45-59 x time	-0.047	-0.060, -0.035	< 0.001	-0.008	-0.019, 0.004	0.182
<b>Education (ref = master's degree)</b>						
Time	-0.028	-0.038, -0.019	< 0.001	0.016	0.010, 0.023	< 0.001
Primary school	0.780	0.437, 1.123	< 0.001	0.266	-0.097, 0.629	0.151
Upper secondary school	1.141	0.939, 1.344	< 0.001	-0.280	-0.443, -0.117	< 0.001
Bachelor's degree or equivalent	0.284	0.076, 0.493	0.008	-0.351	-0.509, -0.193	< 0.001
Primary school x time	0.019	-0.001, 0.040	0.063	-0.024	-0.044, -0.003	0.023
Upper secondary school x time	-0.006	-0.018, 0.006	0.323	-0.007	-0.017, 0.002	0.121
Bachelor's degree x time	0.001	-0.011, 0.014	0.822	-0.006	-0.015, 0.003	0.227

\* Diagonal repeated covariance type was selected for running all specific models in SPSS

<sup>a</sup> Per unit time scale was one month

<sup>b</sup> Unit for volume was kilogram (kg)

<sup>c</sup> p value is significant at < 0.05

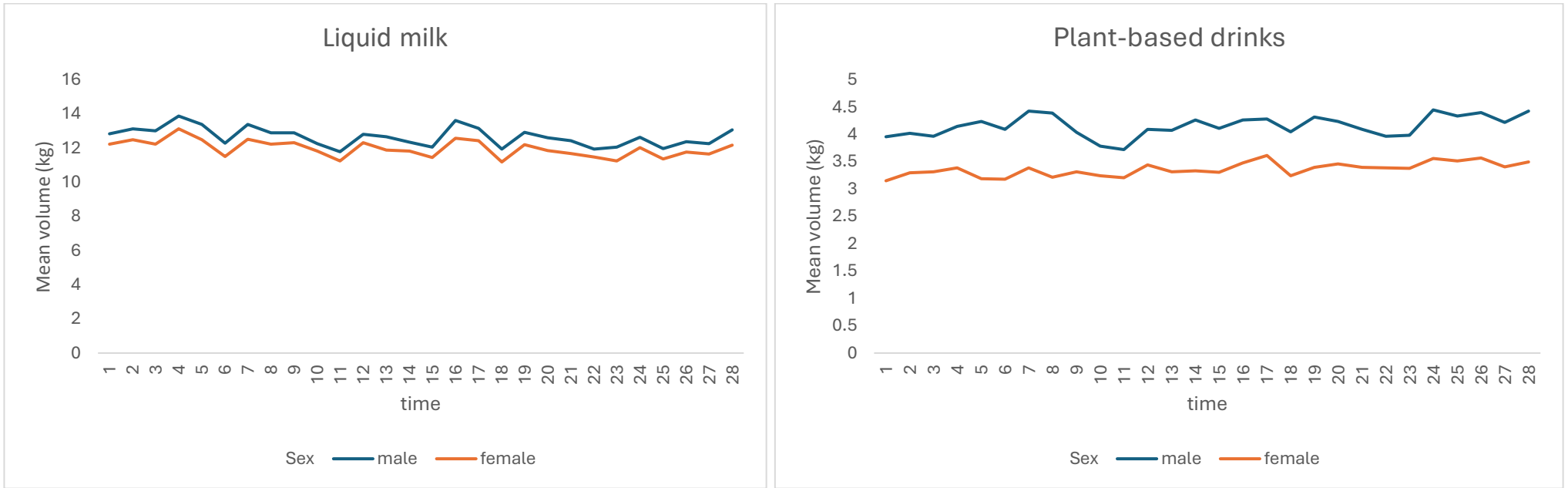


Figure 5: Comparison of purchasing trends between male and female for liquid milk and plant-based drinks

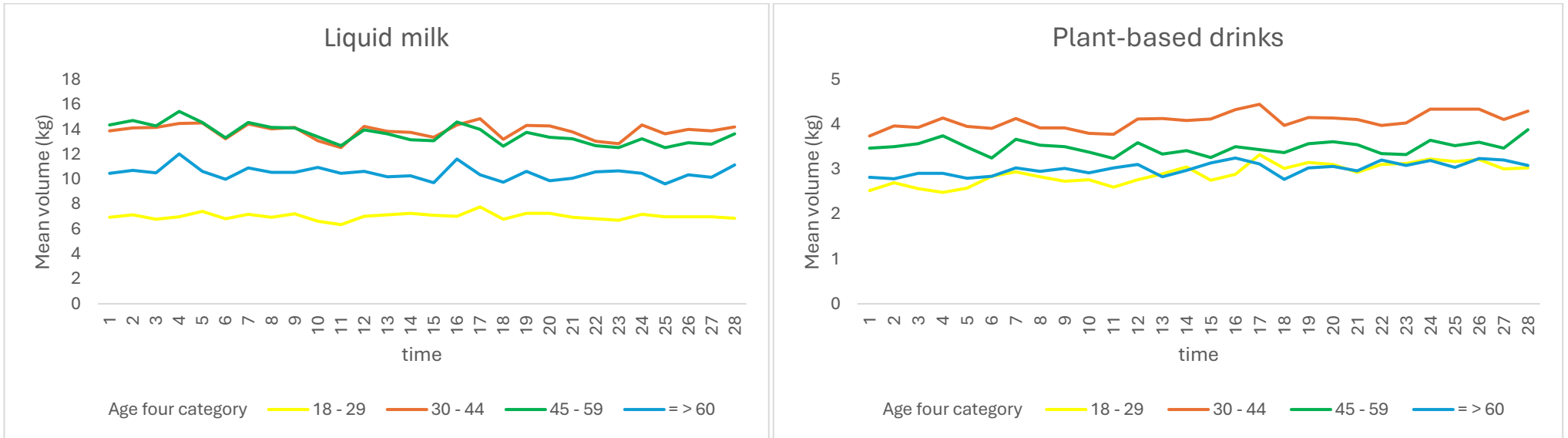


Figure 6: Comparison of purchasing trends between different age categories for liquid milk and plant-based drinks

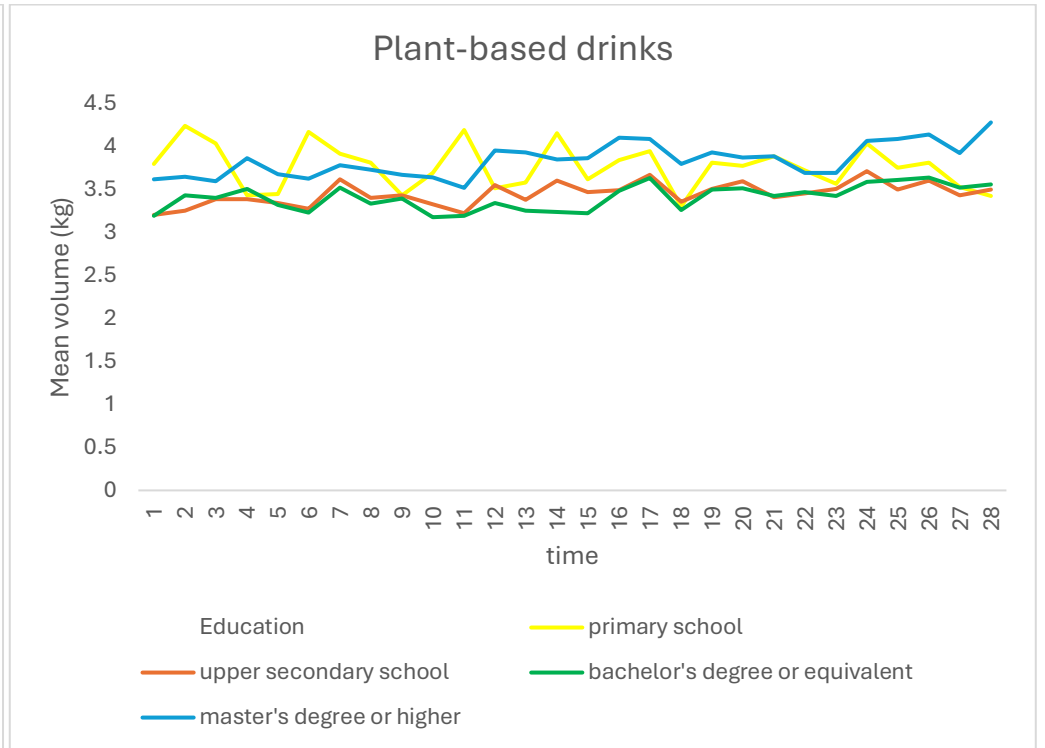
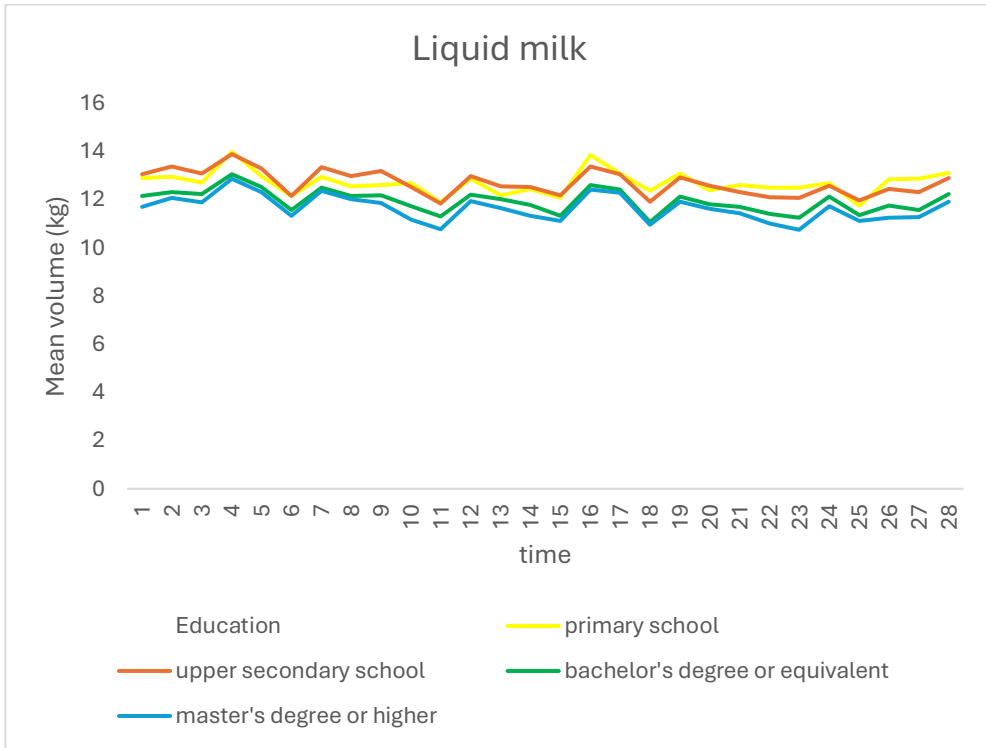


Figure 7: Comparison of purchasing trends between different education groups for liquid milk and plant-based drinks

## **6. DISCUSSION**

This study identified the purchasing patterns of six different types of liquid milk products and plant-based drinks by using the S Group's loyalty cardholder's liquid milk and plant-based drinks purchasing data from September 2016 to December 2018 and how these patterns evolve over time. Additionally, potential associations between three selected sociodemographic factors and the purchasing trends of liquid milk and plant-based drinks were analyzed. The dataset provided by the S Group's loyalty card project demonstrated a comprehensive overview of the purchasing trends for a substantial number of loyalty cardholders representing their households. The average purchased volume for each sociodemographic factor showed a gross idea of how purchasing trends differ from one group to another. Interaction with time for different categories was clearly identifiable from the results. It was found that there were associations between the purchasing volume of liquid milk and plant-based drinks with two different sex, different age groups, and education status groups. Men purchased more liquid milk and plant-based drinks than females. Middle-aged customers showed also increasing purchase patterns for plant-based and liquid milk trends. Higher educational attainment was associated with more plant-based purchase but lower liquid milk purchase in the results. The results have the potential to enhance our understanding of liquid milk and plant-based drinks purchasing tendency by providing insightful information on the effect of demographic factors on these trends.

### **6.1 Purchasing trends of liquid milks and plant-based drinks**

The study discovered the purchasing trend for six different types of liquid milk products. Overall, semi skim milk and skimmed milk dominated the purchasing trends compared to other types of milk. Considerable variation existed in purchasing patterns of semi-skimmed sour milk, other sour milks, and other milks for over two years and this can be explained as normal yearly fluctuation of dairy milk demand. Despite semi skim milk and skimmed milk being the most purchased and most popular choices among loyalty

cardholders, there was clear evidence that the trend was decreasing for skimmed milk over time. The beta coefficients were negative for liquid milk and positive for plant-based drinks in the results. Which means that the liquid milk purchasing volume was decreasing and plant-based drinks volume was increasing by the beta values with one month change in time. However, this change could be stated as moderate change. Additionally, the trend for whole milk peaked in December for all three years. Food choices could differ at different times of the year, and customers' cravings for a specific food might change when the weather or season changes (Spence, 2021). In another study in the United States, Bir et al. (2020) showed that the willingness to purchase special foods during holiday seasons was related to social desirability bias, age, or sex. In relation to the previous research, the purchasing patterns of liquid milk products showed an increasing trend during the winter months in our study. Other possible reasons for this increasing trend could be cultural influences and a rise in the intake of hot drinks, comfort meals, and hot beverages like milk tea or coffee during the winter. Customers might prepare special dishes like cake and pastries for their families with milk during the festive season, and in Finland, some special dishes like rice porridge, casseroles, and desserts are very familiar during the Christmas season.

Conversely, the volume of purchases made of plant-based drinks gradually increased, indicating a growing trend among consumers to favor these products. The total volume purchased by the customers went nearly twice at the end of 2018 compared to the beginning of the study period in September 2016. Throughout this time, the trend had some slight decreases in specific months of the year, but the overall shift was always upward. According to the model results, the purchase of liquid milk decreased by 0.028 kg per month, and the purchase of plant-based drinks increased by 0.011 kg in one month. The purchase of plant-based drinks displayed a steady trend throughout the course of the year, suggesting that it is becoming a popular option for liquid milk among customers. This development is consistent with global trends, as consumers are moving toward plant-based alternatives because of rising health consciousness, and environmental concerns (Erkkola et al., 2022; Hu et al., 2019). Moreover, health complications related to cow milk protein allergies, and lactose intolerance could impact customers' decisions to transition towards plant-based milk alternatives (Silva et al., 2020; Vanga & Raghavan, 2018). The development of new technologies and techniques

to improve the nutritional quality and taste of plant-based drinks could play a role in converting dietary shifts to more sustainable foods (Bocker & Silva 2022; Mehany et al., 2023). However, controversies between customer opinions exist, and not all customers are keen to shift from dairy milk to plant-based drinks (Vanga & Raghavan, 2018). Recently, policies for plant-based drinks have improved compared to those of a decade ago, but these strategies are not yet strong enough to affect customer preferences and psychologies to choose alternative options for liquid milks (Whitley et al., 2018). With growing consumer awareness, animal welfare issues, a strong market for vegan products, and significant initiatives to support and adopt ethically sound sustainable methods for producing plant-based products, these are some of the important points to explain the dietary shift (Tachie et al., 2023). However, it is also true that consumers often assume plant-based products are healthy due to the lack of evidence on their health impacts. When information is missing, consumers form nutritional inferences, and understanding these issues is crucial for effective policy guidance (Wickramasinghe et al., 2021).

## **6.2 Demographic and socioeconomic factors associated with liquid milk and plant-based drinks purchase trends**

The results of this study identified associations between demographic (sex, age) and socioeconomic factors (education, income, and family size) and purchasing patterns of liquid milk and plant-based drinks.

Males were found to purchase more liquid milk products than females, and the trend is similar in plant-based drinks purchases. The average purchased volume for the whole study period was also higher in males than females. Males seemed to purchase 0.683 kg more liquid milk and 0.8 kg more plant-based drinks compared with females, but the interaction between time and sex was not significant, meaning that the decreasing trend in milk purchases did not differ between men and women. The difference in purchasing habits between males and females could be explained by dietary preferences or household shopping roles. Shopping responsibilities for males and females vary from region to region. In the current study, only the primary cardholders' data who had

purchased at least one plant-based drink or at least one liquid milk product and did not have any missing information in the background questionnaire were included in running the specific model analysis. A study in the USA found that the majority of households' males and females were keen to share the responsibility for meal planning, cooking, or food shopping (Flagg et al., 2014). Another study in the USA also found that men who belonged to smaller households and had lower incomes were more likely to participate in all food activities, including food purchases, and men who were younger and those whose female head of family held a full-time job were more likely to plan and prepare meals and food-related things (Harnack et al., 1998). Some studies indicated opposite findings compared with this current study: the choice of preference for liquid milk can also differ in other countries, as females might purchase more milk than males (Kapaj & Deci, 2017). Further research could explore sex-specific consumption patterns.

Age was another significant factor, as younger customers (age 18–29) bought the least amount of liquid milk compared with other age categories but showed a comparatively greater preference for plant-based beverages. Compared with the older customers aged 60 or more, customers aged 18-29 purchased 3.721 kg less liquid milk, but with the interaction of time and age, the purchase volume increased slightly (0.017 kg) in one month than the elderly customers. The average purchased volume for plant-based drinks for age category 18-29 increased compared with elderly customers. This suggests that younger generations may appear to be more inclined to switch to plant-based diets, which is consistent with broader cultural trends towards sustainability and health consciousness (Clarys et al., 2014). The analysis of this study found that middle-aged (age 30-44) customers dominated both the purchasing trend of liquid milk and plant-based drinks. This is not surprising, as middle-aged customers are more likely to have children and other family members in their households, and they are supposed to be the primary earners of the family. However, the liquid milk purchasing volume decreased slightly over time for age group 45-59 by 0.047 kg in one month. The study found a lower purchasing trend for plant-based drinks among older customers (age 60 or older), which indicates that they seem to be reluctant to try newer plant-based food items. However, a recent study in China suggested that plant-based diet reduced frailty risk in men and healthy older adults and should be recommended for dietary intervention and lifestyle modification to promote successful aging, especially for women (Duan et al., 2023).

Another study in Spain found similar findings, as elderly people who follow a plant-based diet might feel more secure knowing that their diet is working as a protective factor against physical inability and impairment (Maroto-Rodriguez et al., 2023). Perhaps lack of knowledge or information on sustainability issues might play an important role in encouraging elderly customers to make a shift, and future initiatives should be prioritized to understand their perceptions of plant-based foods.

Educational attainment influenced purchasing behaviors significantly in the current study results. Higher educational attainment could be associated with greater health consciousness or environmental awareness, as seen by the association between higher education and the purchase of plant-based drinks. Customers with a master's degree or higher educational status tended to buy more plant-based beverages and less liquid milk, suggesting a potential relationship between education and acceptance or understanding of alternative diets. Moreover, the model results indicated that customers who had primary school educational attainment purchased fewer plant-based drinks over time compared with those who had a master's degree. This trend could be attributed to higher health literacy and increased exposure to information about the benefits of plant-based diets among more educated individuals (Corrin & Papadopoulos, 2017). Another recent study indicated that higher diet quality was linked to food literacy and general nutrition knowledge among vegetarians (Groufh-Jacobsen et al., 2023). A recent study in Finland found a similar association between higher education and a shift from animal meat towards plant-based dietary practices and predicted that being young, highly educated, and living in urban areas are closely related to following plant-based trends (Nevalainen et al., 2023). Prioritizing nutritional knowledge in the education curriculum might lead youth customers to understand more about plant-based items and their health benefits. Moreover, increased nutrition literacy and understanding are the outcomes of more hours spent in nutrition education, and this could result in dietary practices that promote health. Therefore, nutrition education in schools can be viewed as a preventive measure to raise adolescents' nutritional skills, regardless of their socioeconomic status (Egg et al., 2020).

The current study found that higher-income loyalty cardholders purchased more liquid milk and plant-based drinks on average compared with other income groups. The result might reflect the affordability and perceived necessity of traditional dairy milk products

compared to plant-based alternatives. However, income levels not significantly affecting plant-based drink purchases infer that these liquid milk alternatives might be reaching a broader income range in society. Additionally, higher income holders might eat more plant-based drinks outside of their households during office hours as snacks and with afternoon tea or coffee. Eating in restaurants during holidays and weekends is more common in high-income households than in low-income households. In contrast, customers with a low-income level might have the tendency to buy carefully according to their necessities, generating less food waste to match their earnings. Another recent study also found that income level might have some effects on the preference for plant-based items, and socioeconomic differences may restrict the intake of healthy foods and be a factor in the high incidence of unfavorable health outcomes that affect particular demographic groups (Gonzalvo et al., 2024). This might demonstrate that the shift towards plant-based items could be justified by price differences between liquid milk products and plant-based drinks. Moreover, the findings of the current study might illustrate the perceived necessity and affordability of conventional milk products in comparison to their plant-based counterparts, which are often perceived as luxury or niche products (Hirvonen et al., 2020).

The findings of this study also demonstrated the potential linkage between household size and the purchase behavior of liquid milk products and plant-based drinks. As expected, larger families purchased more of both product types, indicating higher overall consumption needs. This pattern emphasizes how household dynamics affect food consumption and food shopping habits for larger households (Herbst & Stanton, 2007). On the other hand, the average purchased volumes for plant-based drinks did not vary so much between family sizes as for liquid milk products. This might be because the data only included the primary cardholder's purchase information, and other family members could buy their own preferred plant-based products elsewhere.

### **6.3 Strengths and limitations of the study**

The advantages of this study include the use of an exceptionally large dataset and an extensive and long follow-up period. Additionally, the automatic data collection and

objectivity since participants were not required to keep a record of the food items they bought and it was unlikely to intentionally or erroneously report purchases that were not made. Therefore, it was possible to acquire large purchase data without imposing excessive strain on participants or researchers. The data featured real longitudinal criteria for over two years from the largest grocery retailer, S Group's, consented loyalty cardholders in Finland. Customer loyalty card data does not suffer from recall bias or under- or over-reporting, in contrast to self-reported food intake statistics. The data were precise in capturing monthly variations and trends in liquid milk products and plant-based drinks as they spanned a long time period. Analyzing the data yielded the between person and within person variation over the years appropriately by using the linear mixed effects model (LMM). This approach helped to clearly understand and interpret the associations between sociodemographic factors and purchasing trends for liquid milk and plant-based drinks.

A few limitations or weaknesses need to be listed regarding the present study. Some milk or plant-based items could have been purchased from other grocery stores even if the retailer in consideration accounted for the majority of purchases, particularly for respondents who stated that they only purchased between 61% and 80% of their groceries from them. This study used data from one household's loyalty card holder. As a result, not all of the liquid milk types or plant-based drinks for the household were included in the study's dataset. Other household members might have purchased liquid milk or plant-based items from another grocery store, resulting in a possible systematic bias. It is possible that customers of different grocery stores could have different purchasing patterns for milk and plant-based drinks.

The participating cardholders of this study were dominated by female customers; more than half of the cardholders had at least a bachelor's degree or higher educational status, and nearly two-thirds were earning more than 3000 euros per month. Therefore, the specific purchasing trends of liquid milk and plant-based drinks for men and cardholders with lower educational status and income could differ slightly in comparison with other relevant studies. Additionally, milk consumption trends are usually higher in Nordic countries than in other regions of the world (Holm et al., 2020). The fact that the data was obtained from Finland may restrict its applicability to other regions with different

populations, customs, demographics, market dynamics, and product availability. The study had only one data category for plant-based drinks. Differentiating between options like soy milk, almond milk, oat milk, etc., could reveal specific trends within the category.

#### **6.4 Recommendations and suggestions for future work**

To develop and understand the detailed purchasing patterns for different plant-based drinks, additional studies will be required. New technologies and techniques are introduced by the plant-based drink industry, and it would be necessary to investigate their nutritional value and health benefits in future studies. The increasing popularity of plant-based drinks offers significant opportunities for manufacturers and retailers. Therefore, companies should consider investing in more research projects to understand the demographic associations that are more related to purchasing plant-based drinks. Additionally, policies that support the accessibility and affordability of plant-based items could further evaluate their strategies based on the current and future studies. Studies might look into the real environmental impact of plant-based beverage consumption as opposed to dairy production, as well as the possible health effects of increased plant-based drink consumption. A deeper understanding of the long-term trends and effects of emerging dietary habits may be obtained by longitudinal studies conducted beyond the two-year study period. In addition, qualitative studies using focus group discussion or in-depth interviews could delve deeper into the motivational factors and perceptions behind consumers' preference for plant-based drinks or liquid milk. This will complement the existing quantitative studies and encourage further research. Lastly, to enhance the generalizability of the results, consumption patterns in many nations or areas with diverse cultural and economic contexts could be investigated.

## 7. CONCLUSION

This study has provided insights into the purchasing patterns of liquid milk and plant-based drinks in Finland by emphasizing the influence of demographic and socioeconomic factors. The findings reveal a declining trend in liquid milk purchases and a rising trend in plant-based drinks, suggesting a potential shift in consumer behavior associated with sociodemographic factors like higher education, age difference, and sex. Younger customers have clearly demonstrated a dietary shift from liquid milk to plant-based drinks, and educational status or health consciousness might have played a key role in this change in purchasing patterns. Although the findings of this study have found significant associations between different sociodemographic factors and the shift towards plant-based drinks, scenarios could be different in the context of developing and underdeveloped countries. Ongoing research and public health intervention strategies will be essential for understanding the shifting terrain of dairy milk consumption and the plant-based drinks sector, as customer preferences might continue to change in the coming years.

## REFERENCES

- Ahmad, N., Rahman, A. B., Harun, S. N. F., Salleh, K., & Jasman, N. (2023). Literature Review On Factors Influencing Milk Consumption Behaviour Among Adults. *International Journal of Public Health Research*, 13(1), Article 1. <https://doi.org/10.17576/ijphr.1301.2023.05>
- Alae-Carew, C., Green, R., Stewart, C., Cook, B., Dangour, A. D., & Scheelbe ek, P. F. D. (2022). The role of plant-based alternative foods in sustainable and healthy food systems: Consumption trends in the UK. *Science of The Total Environment*, 807, 151041. <https://doi.org/10.1016/j.scitotenv.2021.151041>
- Bir, C. L., Olynk Widmar, N. J., Davis, M. K., Erasmus, M. A., & Zuelly, S. (2020). Willingness to pay for whole turkey attributes during Thanksgiving holiday shopping in the United States. *Poultry Science*, 99(5), 2798–2810. <https://doi.org/10.1016/j.psj.2019.12.047>
- Blomhoff, R., Andersen, R., Arnesen, E.K., Christensen, J.J., Eneroth, H., Erkkola, M., Gudaviciene, I., Halldorsson, T.I., Høyer-Lund, A., Lemming, E.W., Meltzer, H.M., Pitsi, T., Schwab, U., Siksna, I., Thorsdottir, I. and Trolle, E. (2023). *Nordic Nutrition Recommendations 2023*. Copenhagen: Nordic Council of Ministers, 2023 <https://norden.diva-portal.org/smash/get/diva2:1769986/FULLTEXT06.pdf>
- Boaitey, A., & Minegishi, K. (2020). Determinants of Household Choice of Dairy and Plant-based Milk Alternatives: Evidence from a Field Survey. *Journal of Food Products Marketing*, 26(9), 639–653. <https://doi.org/10.1080/10454446.2020.1857318>
- Bocker, R., & Silva, E. K. (2022). Innovative technologies for manufacturing plant-based non-dairy alternative milk and their impact on nutritional, sensory and safety aspects. *Future Foods*, 5, 100098. <https://doi.org/10.1016/j.fufo.2021.100098>

- Boniface, B., & Umberger, W. J. (2012). Factors influencing Malaysian consumers' consumption of dairy products. Contributed paper prepared for presentation at the 56th AARES annual conference, Fremantle, Western Australia.  
<https://doi.org/10.22004/ag.econ.124243>
- Brooker, P. G., Anastasiou, K., Smith, B. P. C., Tan, R., Cleanthous, X., & Riley, M. D. (2023). Nutrient composition of milk and plant-based milk alternatives: A cross-sectional study of products sold in Australia and Singapore. *Food Research International*, 173, 113475. <https://doi.org/10.1016/j.foodres.2023.113475>
- Burek, J., Kim, D., Nutter, D., Selke, S., Auras, R., Cashman, S., Sauer, B., & Thoma, G. (2018). Environmental Sustainability of Fluid Milk Delivery Systems in the United States. *Journal of Industrial Ecology*, 22(1), 180–195.  
<https://doi.org/10.1111/jiec.12531>
- Carlsson-Kanyama, A., & González, A. D. (2009). Potential contributions of food consumption patterns to climate change<sup>23</sup>. *The American Journal of Clinical Nutrition*, 89(5), 1704S-1709S. <https://doi.org/10.3945/ajcn.2009.26736AA>
- Chalupa-Krebzdak, S., Long, C. J., & Bohrer, B. M. (2018). Nutrient density and nutritional value of milk and plant-based milk alternatives. *International Dairy Journal*, 87, 84–92. <https://doi.org/10.1016/j.idairyj.2018.07.018>
- Clarys, P., Deliens, T., Huybrechts, I., Deriemaeker, P., Vanaelst, B., De Keyzer, W., Hebbelinck, M., & Mullie, P. (2014). Comparison of Nutritional Quality of the Vegan, Vegetarian, Semi-Vegetarian, Pesco-Vegetarian and Omnivorous Diet. *Nutrients*, 6(3), Article 3. <https://doi.org/10.3390/nu6031318>
- Clegg, M. E., Tarrado Ribes, A., Reynolds, R., Kliem, K., & Stergiadis, S. (2021). A comparative assessment of the nutritional composition of dairy and plant-based dairy alternatives available for sale in the UK and the implications for consumers'

dietary intakes. *Food Research International*, 148, 110586.

<https://doi.org/10.1016/j.foodres.2021.110586>

Collard, K. M., & McCormick, D. P. (2021). A Nutritional Comparison of Cow's Milk and Alternative Milk Products. *Academic Pediatrics*, 21(6), 1067–1069.

<https://doi.org/10.1016/j.acap.2020.12.007>

Corrin, T., & Papadopoulos, A. (2017). Understanding the attitudes and perceptions of vegetarian and plant-based diets to shape future health promotion programs.

*Appetite*, 109, 40–47. <https://doi.org/10.1016/j.appet.2016.11.018>

Delgado, C. L. (2003). Rising Consumption of Meat and Milk in Developing Countries Has Created a New Food Revolution. *The Journal of Nutrition*, 133(11), 3907S–3910S.

<https://doi.org/10.1093/jn/133.11.3907S>

Duan, Y., Qi, Q., Gao, T., Du, J., Zhang, M., & Liu, H. (2023). Plant-Based Diet and Risk of Frailty in Older Chinese Adults. *The Journal of Nutrition, Health and Aging*, 27(5), 371–377.

<https://doi.org/10.1007/s12603-023-1918-9>

Egg, S., Wakolbinger, M., Reisser, A., Schätzer, M., Wild, B., & Rust, P. (2020). Relationship between nutrition knowledge, education and other determinants of food intake and lifestyle habits among adolescents from urban and rural secondary schools in Tyrol, Western Austria. *Public Health Nutrition*, 23(17), 3136–3147.

<https://doi.org/10.1017/S1368980020000488>

Erkkola, M., Kinnunen, S. M., Vepsäläinen, H. R., Meinilä, J. M., Uusitalo, L., Konttinen, H., Saarijärvi, H., Fogelholm, M., & Nevalainen, J. (2022). A slow road from meat dominance to more sustainable diets: An analysis of purchase preferences among Finnish loyalty-card holders. *PLOS Sustainability and Transformation*, 1(6), e0000015.

<https://doi.org/10.1371/journal.pstr.0000015>

- Faye, B., & Konuspayeva, G. (2012). The sustainability challenge to the dairy sector – The growing importance of non-cattle milk production worldwide. *International Dairy Journal*, 24(2), 50–56. <https://doi.org/10.1016/j.idairyj.2011.12.011>
- Finnish Grocery Trade Association. (2019). *Finnish Grocery Trade 2019*. Erweko Oy 2019, Helsinki. <https://www.pty.fi/wp-content/uploads/2021/08/Finnish-Grocery-trade-2019.pdf>
- Finnish Institute for Health and Welfare. (n.d.). *Fineli-Food itmes*. Retrieved May 20, 2024, from <https://fineli.fi/fineli/en/elintarvikkeet/606>
- Flagg, L. A., Sen, B., Kilgore, M., & Locher, J. L. (2014). The influence of gender, age, education and household size on meal preparation and food shopping responsibilities. *Public Health Nutrition*, 17(9), 2061–2070. <https://doi.org/10.1017/S1368980013002267>
- Food and Agriculture Organization of the United Nations. (2013). *Milk and Dairy Products in Human Nutrition*. <https://www.fao.org/4/i3396e/i3396e.pdf>
- Gaucheron, F. (2011). Milk and Dairy Products: A Unique Micronutrient Combination. *Journal of the American College of Nutrition*, 30(sup5), 400S-409S. <https://doi.org/10.1080/07315724.2011.10719983>
- Gerosa, S., & Skoet, J. (2012). Milk availability: Trends in production and demand and medium-term outlook (Working Paper No. 12-01; ESA Working Paper). *Agricultural Development Economics Division, Food and Agriculture Organization of the United Nations (FAO)*. <https://doi.org/10.22004/ag.econ.289000>
- Giacalone, D., Clausen, M. P., & Jaeger, S. R. (2022). Understanding barriers to consumption of plant-based foods and beverages: Insights from sensory and

consumer science. *Current Opinion in Food Science*, 48, 100919.

<https://doi.org/10.1016/j.cofs.2022.100919>

Godos, J., Tieri, M., Ghelfi, F., Titta, L., Marventano, S., Lafranconi, A., Gambera, A., Alonzo, E., Sciacca, S., Buscemi, S., Ray, S., Del Rio, D., Galvano, F., & Grosso, G. (2020). Dairy foods and health: An umbrella review of observational studies. *International Journal of Food Sciences and Nutrition*, 71(2), 138–151.

<https://doi.org/10.1080/09637486.2019.1625035>

Gonzalzo, M. R., Nackeeran, S., Mouzannar, A., & Blachman-Braun, R. (2024).

Socioeconomic differences associated with consumption of a plant-based diet: Results from the national health and nutrition examination survey. *Nutrition and Health*, 30(2), 253–259. <https://doi.org/10.1177/02601060221109669>

Groufh-Jacobsen, S., Larsson, C., Daele, W. V., Margerison, C., Mulkerrins, I., Aasland, L. M., & Medin, A. C. (2023). Food literacy and diet quality in young vegans, lacto-ovo vegetarians, pescatarians, flexitarians and omnivores. *Public Health Nutrition*, 26(12), 3051–3061. <https://doi.org/10.1017/S1368980023002124>

Haas, R., Schnepps, A., Pichler, A., & Meixner, O. (2019). Cow Milk versus Plant-Based Milk Substitutes: A Comparison of Product Image and Motivational Structure of Consumption. *Sustainability*, 11(18), Article 18.

<https://doi.org/10.3390/su11185046>

Harnack, L., Story, M., Martinson, B., Neumark-sztainer, D., & Stang, J. (1998). Guess Who's Cooking? The Role of Men in Meal Planning, Shopping, and Preparation in US Families. *Journal of the American Dietetic Association*, 98(9), 995–1000.

[https://doi.org/10.1016/S0002-8223\(98\)00228-4](https://doi.org/10.1016/S0002-8223(98)00228-4)

Haug, A., Høstmark, A. T., & Harstad, O. M. (2007). Bovine milk in human nutrition – a review. *Lipids in Health and Disease*, 6, 25. [https://doi.org/10.1186/1476-511X-](https://doi.org/10.1186/1476-511X-6-25)

[6-25](https://doi.org/10.1186/1476-511X-6-25)

- Heck, R. H., Thomas, S. L., & Tabata, L. N. (2022). *Multilevel and Longitudinal Modeling with IBM SPSS* (3rd ed.). Routledge Taylor & Francis.  
<https://doi.org/10.4324/9780367824273>
- Henchion, M., Moloney, A. P., Hyland, J., Zimmermann, J., & McCarthy, S. (2021). Review: Trends for meat, milk and egg consumption for the next decades and the role played by livestock systems in the global production of proteins. *Animal*, *15*, 100287. <https://doi.org/10.1016/j.animal.2021.100287>
- Herbst, K. C., & Stanton, J. L. (2007). Changes in family dynamics predict purchase and consumption. *British Food Journal*, *109*(8), 648–655.  
<https://doi.org/10.1108/00070700710772435>
- Hirvonen, K., Bai, Y., Headey, D., & Masters, W. A. (2020). Affordability of the EAT–Lancet reference diet: A global analysis. *The Lancet Global Health*, *8*(1), e59–e66.  
[https://doi.org/10.1016/S2214-109X\(19\)30447-4](https://doi.org/10.1016/S2214-109X(19)30447-4)
- Holm, L., Kjærnes, U., & Niva, M. (2020). Eating and Drinking in Four Nordic Countries: Recent Changes. In H. L. Meiselman (Ed.), *Handbook of Eating and Drinking: Interdisciplinary Perspectives* (pp. 1323–1341). Springer International Publishing. [https://doi.org/10.1007/978-3-030-14504-0\\_126](https://doi.org/10.1007/978-3-030-14504-0_126)
- Hu, F. B., Otis, B. O., & McCarthy, G. (2019). Can Plant-Based Meat Alternatives Be Part of a Healthy and Sustainable Diet? *JAMA*, *322*(16), 1547–1548.  
<https://doi.org/10.1001/jama.2019.13187>
- Islam, N., Shafiee, M., & Vatanparast, H. (2021). Trends in the consumption of conventional dairy milk and plant-based beverages and their contribution to nutrient intake among Canadians. *Journal of Human Nutrition and Dietetics*, *34*(6), 1022–1034. <https://doi.org/10.1111/jhn.12910>

- Kanerva, N., Kinnunen, S., Nevalainen, J., Vepsäläinen, H., fogelholm, M., Saarijärvi, H., Meinilä, J., & Erkkola, M. (2023). *Building nutritionally meaningful product groups for loyalty card data: The LoCard Food Classification process*. <https://doi.org/10.21203/rs.3.rs-2826970/v1>
- Kapaj, A., & Deci, E. (2017). Chapter 7—World Milk Production and Socio-Economic Factors Effecting Its Consumption. In R. R. Watson, R. J. Collier, & V. R. Preedy (Eds.), *Dairy in Human Health and Disease Across the Lifespan* (pp. 107–115). Academic Press. <https://doi.org/10.1016/B978-0-12-809868-4.00007-8>
- Katoch, G. K., Nain, N., Kaur, S., & Rasane, P. (2022). Lactose Intolerance and Its Dietary Management: An Update. *Journal of the American Nutrition Association*, 41(4), 424–434. <https://doi.org/10.1080/07315724.2021.1891587>
- Krizsan, S. J., Chagas, J. C., Pang, D., & Cabezas-Garcia, E. H. (2021). Sustainability aspects of milk production in Sweden. *Grass and Forage Science*, 76(2), 205–214. <https://doi.org/10.1111/gfs.12539>
- Kumar, A., Joshi, P. K., Kumar, P., & Parappurathu, S. (2014). Trends in the consumption of milk and milk products in India: Implications for self-sufficiency in milk production. *Food Security*, 6(5), 719–726. <https://doi.org/10.1007/s12571-014-0376-y>
- Kurajdová, K., Táborecká-Petrovičová, J., & Kaščáková, A. (2015). Factors Influencing Milk Consumption and Purchase Behavior – Evidence from Slovakia. *Procedia Economics and Finance*, 34, 573–580. [https://doi.org/10.1016/S2212-5671\(15\)01670-6](https://doi.org/10.1016/S2212-5671(15)01670-6)
- Kyttälä, P., Erkkola, M., Kronberg-Kippilä, C., Tapanainen, H., Veijola, R., Simell, O., Knip, M., & Virtanen, S. M. (2010). Food consumption and nutrient intake in Finnish 1–6-year-old children. *Public Health Nutrition*, 13(6A), 947–956. <https://doi.org/10.1017/S136898001000114X>

- Lyytikäinen, A., Lamberg-Allardt, C., Kannas, L., & Cheng, S. (2005). Food consumption and nutrient intakes with a special focus on milk product consumption in early pubertal girls in Central Finland. *Public Health Nutrition*, 8(3), 284–289. <https://doi.org/10.1079/PHN2004703>
- Marangoni, F., Pellegrino, L., Verduci, E., Ghiselli, A., Bernabei, R., Calvani, R., Cetin, I., Giampietro, M., Perticone, F., Piretta, L., Giacco, R., La Vecchia, C., Brandi, M. L., Ballardini, D., Banderali, G., Bellentani, S., Canzone, G., Cricelli, C., Faggiano, P., ... Poli, A. (2019). Cow's Milk Consumption and Health: A Health Professional's Guide. *Journal of the American College of Nutrition*, 38(3), 197–208. <https://doi.org/10.1080/07315724.2018.1491016>
- Maroto-Rodriguez, J., Delgado-Velandia, M., Ortolá, R., Carballo-Casla, A., García-Esquinas, E., Rodríguez-Artalejo, F., & Sotos-Prieto, M. (2023). Plant-based diets and risk of frailty in community-dwelling older adults: The Seniors-ENRICA-1 cohort. *GeroScience*, 45(1), 221–232. <https://doi.org/10.1007/s11357-022-00614-3>
- McCarthy, K. S., Parker, M., Ameerally, A., Drake, S. L., & Drake, M. A. (2017). Drivers of choice for fluid milk versus plant-based alternatives: What are consumer perceptions of fluid milk? *Journal of Dairy Science*, 100(8), 6125–6138. <https://doi.org/10.3168/jds.2016-12519>
- McGill, C. R., Fulgoni III, V. L., DiRienzo, D., Huth, P. J., Kurilich, A. C., & Miller, G. D. (2008). Contribution of Dairy Products to Dietary Potassium Intake in the United States Population. *Journal of the American College of Nutrition*, 27(1), 44–50. <https://doi.org/10.1080/07315724.2008.10719673>
- Mehany, T., Siddiqui, S. A., Olawoye, B., Popoola, O. O., Hassoun, A., Manzoor, M. F., & Bangar, S. P. (2023). Recent innovations and emerging technological advances used to improve quality and process of plant-based milk analogs. *Critical*

*Reviews in Food Science and Nutrition*, 1–31.

<https://doi.org/10.1080/10408398.2023.2183381>

Moss, R., Barker, S., Falkeisen, A., Gorman, M., Knowles, S., & McSweeney, M. B. (2022). An investigation into consumer perception and attitudes towards plant-based alternatives to milk. *Food Research International*, 159, 111648.

<https://doi.org/10.1016/j.foodres.2022.111648>

Natural Resources Institute Finland (2024, May). *Consumption of food commodities per capita by Year and Commodity*.

[https://statdb.luke.fi/PxWeb/pxweb/en/LUKE/LUKE\\_02%20Maatalous\\_08%20Muut\\_02%20Ravintotase/01\\_Elintarvikkeiden\\_kulutus.px/?rxid=dc711a9e-de6d-454b-82c2-74ff79a3a5e0](https://statdb.luke.fi/PxWeb/pxweb/en/LUKE/LUKE_02%20Maatalous_08%20Muut_02%20Ravintotase/01_Elintarvikkeiden_kulutus.px/?rxid=dc711a9e-de6d-454b-82c2-74ff79a3a5e0)

Nevalainen, E., Niva, M., & Vainio, A. (2023). A transition towards plant-based diets on its way? Consumers' substitutions of meat in their diets in Finland. *Food Quality and Preference*, 104, 104754.

<https://doi.org/10.1016/j.foodqual.2022.104754>

Park, Y. W., & Haenlein, G. F. W. (2013). *Milk and Dairy Products in Human Nutrition: Production, Composition and Health*. John Wiley & Sons.

Paul, A. A., Kumar, S., Kumar, V., & Sharma, R. (2020). Milk Analog: Plant based alternatives to conventional milk, production, potential and health concerns. *Critical Reviews in Food Science and Nutrition*, 60(18), 3005–3023.

<https://doi.org/10.1080/10408398.2019.1674243>

Pereira, P. C. (2014). Milk nutritional composition and its role in human health.

*Nutrition*, 30(6), 619–627. <https://doi.org/10.1016/j.nut.2013.10.011>

Reyes-Jurado, F., Soto-Reyes, N., Dávila-Rodríguez, M., Lorenzo-Leal, A. C., Jiménez-Munguía, M. T., Mani-López, E., & López-Malo, A. (2023). Plant-Based Milk

Alternatives: Types, Processes, Benefits, and Characteristics. *Food Reviews International*, 39(4), 2320–2351. <https://doi.org/10.1080/87559129.2021.1952421>

Roustaei, R., Eini-Zinab, H., Ghodsi, D., Mehrparvar Hosseini, E., Omidvar, N., Hosseini, H., Hosseini Mousavi, S. O., & Rafiee, H. (2024). A 30-year trend of dairy consumption and its determinants among income groups in Iranian households. *Frontiers in Public Health*, 12, 1261293. <https://doi.org/10.3389/fpubh.2024.1261293>

Salter, A. M. (2017). Improving the sustainability of global meat and milk production. *Proceedings of the Nutrition Society*, 76(1), 22–27. <https://doi.org/10.1017/S0029665116000276>

Sethi, S., Tyagi, S. K., & Anurag, R. K. (2016). Plant-based milk alternatives an emerging segment of functional beverages: A review. *Journal of Food Science and Technology*, 53(9), 3408–3423. <https://doi.org/10.1007/s13197-016-2328-3>

Silva, A. R. A., Silva, M. M. N., & Ribeiro, B. D. (2020). Health issues and technological aspects of plant-based alternative milk. *Food Research International*, 131, 108972. <https://doi.org/10.1016/j.foodres.2019.108972>

Spence, C. (2021). Explaining seasonal patterns of food consumption. *International Journal of Gastronomy and Food Science*, 24, 100332. <https://doi.org/10.1016/j.ijgfs.2021.100332>

Tachie, C., Nwachukwu, I. D., & Aryee, A. N. A. (2023). Trends and innovations in the formulation of plant-based foods. *Food Production, Processing and Nutrition*, 5(1), 16. <https://doi.org/10.1186/s43014-023-00129-0>

- Thorning, T. K., Raben, A., Tholstrup, T., Soedamah-Muthu, S. S., Givens, I., & Astrup, A. (2016). Milk and dairy products: Good or bad for human health? An assessment of the totality of scientific evidence. *Food & Nutrition Research*, 60(1), 32527. <https://doi.org/10.3402/fnr.v60.32527>
- Tricarico, J. M., Kebreab, E., & Wattiaux, M. A. (2020). MILK Symposium review: Sustainability of dairy production and consumption in low-income countries with emphasis on productivity and environmental impact\*. *Journal of Dairy Science*, 103(11), 9791–9802. <https://doi.org/10.3168/jds.2020-18269>
- Vanga, S. K., & Raghavan, V. (2018). How well do plant based alternatives fare nutritionally compared to cow's milk? *Journal of Food Science and Technology*, 55(1), 10–20. <https://doi.org/10.1007/s13197-017-2915-y>
- Vuorinen, A.-L., Erkkola, M., Fogelholm, M., Kinnunen, S., Saarijärvi, H., Uusitalo, L., Näppilä, T., & Nevalainen, J. (2020). Characterization and Correction of Bias Due to Nonparticipation and the Degree of Loyalty in Large-Scale Finnish Loyalty Card Data on Grocery Purchases: Cohort Study. *Journal of Medical Internet Research*, 22(7), e18059. <https://doi.org/10.2196/18059>
- Whitley, C. T., Gunderson, R., & Charters, M. (2018). Public receptiveness to policies promoting plant-based diets: Framing effects and social psychological and structural influences. *Journal of Environmental Policy & Planning*, 20(1), 45–63. <https://doi.org/10.1080/1523908X.2017.1304817>

Wickramasinghe, K., Breda, J., Berdzuli, N., Rippin, H., Farrand, C., & Halloran, A. (2021). The shift to plant-based diets: Are we missing the point? *Global Food Security*, 29, 100530. <https://doi.org/10.1016/j.gfs.2021.100530>

Zhang, X., Chen, X., Xu, Y., Yang, J., Du, L., Li, K., & Zhou, Y. (2021). Milk consumption and multiple health outcomes: Umbrella review of systematic reviews and meta-analyses in humans. *Nutrition & Metabolism*, 18(1), 7. <https://doi.org/10.1186/s12986-020-00527-y>

## APPENDICES

Appendix 1: Total purchased volume for specific products and month in year

Month in year	Plant-based drinks	Other milks	Other sour milks	Semi skim milk	Semi skim sour	Skimmed milk	Whole milk
2016-9	8330.44	16569.33	8436	92872.8	195.05	89429.75	11757.4
2016-10	8826.5	17702.08	8730.75	95694.5	234.2	90242.45	12579
2016-11	8401.26	17571.41	8430.25	94811.95	219.05	87063.3	13227.1
2016-12	8795.88	18869.97	9512.75	100602.6	281.6	89935.2	22563.04
2017-1	9546.24	18533.61	9059	97468.05	212.1	89675.35	13055.7
2017-2	9084.68	17539.89	8330.75	89839.3	176.3	80331.25	11900.54
2017-3	10512.06	19600.19	9503.25	98286.75	209.9	88382.55	12826.56
2017-4	10241.4	18754.75	8951	97175.25	183.4	85441.7	12787.1
2017-5	10331.34	19083.75	8939	97412.5	211.7	85454.1	12141.2
2017-6	9942.22	18482.47	8938	94608.65	214.05	80705.15	12447.5
2017-7	9679.85	16942.02	8225.5	91015.4	171.15	76333.2	12126
2017-8	11520.34	18806.05	8983	99746.35	199.3	85407.55	12935.5
2017-9	11748.91	18919.13	8644.25	96519.6	235.85	81535.05	12788.5
2017-10	11927.6	19195.95	8492.75	96689.85	194.55	78944.7	13435.5
2017-11	11357.4	18224.85	8345.25	93004.45	181.05	74791.2	13636.5
2017-12	12301.6	20473.89	9481	103093.8	264.9	80963.55	25053.5
2018-1	13995.03	20486.04	9178.5	102059.6	233.8	82897.3	14199
2018-2	13036.29	18037.99	8173.5	92366.75	176.5	73709.45	13334
2018-3	14636.05	19961.43	9061.25	101830.8	222.8	81366.65	14353
2018-4	13884.21	19406.65	8596	98735.2	188.6	79767.2	12699.5
2018-5	14154	19061.65	8743.5	97339.1	171.5	78071.95	12229
2018-6	14123.17	18530.53	8739	95582.55	212.5	75774.55	12709
2018-7	14319.27	18213.85	8869	94858.85	237.5	74812.3	12466
2018-8	16007.72	19838.29	9150.75	99018.3	223.1	81131	12915.5
2018-9	15282.64	18082.59	8386.75	92253.5	195.45	75079.7	12823
2018-10	15611.93	19330.46	8662.5	96005.35	241.55	76779.4	13674
2018-11	14435.16	18916.4	8924.75	93580.95	234	74704.35	14343.5
2018-12	15969.65	19804.59	9609.5	98890.6	281.75	75925.85	23955