Effect of knowledge about artificial sweeteners on choices made by Dutch consumers

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Preface

This bachelor's thesis has been written as a requirement of the 4th year for the dual-degree bachelor's study in International Food Business at the Aeres University of Applied Sciences and the Dalhousie University. My name is Jill Holtkuile, and I am a 23-year-old student from The Netherlands.

Within my entire study program, I have had an interest in understanding the effects of food products on the human body and exploring why people make certain food choices. This topic has been of great personal interest to me and has positively influenced my approach to writing this thesis

I would like to thank my coach Cynthia Akkermans for guiding me through the process of writing the thesis and providing me with valuable feedback. Furthermore, I would also like to thank my boyfriend Robbin de Bruijn, my family and my friends for supporting me throughout writing this thesis and my entire study.

I sincerely hope that you find my research project enjoyable to read.

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Summary

Artificial sweeteners are promoted as a healthier alternative to sugar, with the aim of reducing sugar consumption. However, conflicting research findings regarding the benefits and drawbacks of these sweeteners create challenges for the general public in making informed choices. In particular, marketing campaigns that mislead consumers about the healthfulness of products sweetened with artificial sugar can significantly influence their decision-making, especially when consumers have insufficient knowledge about the impacts of these sweeteners. Therefore, the main research question of this study is whether consumers would make different decisions if they possessed knowledge about artificial sweeteners.

To address this question, an online questionnaire was distributed through social media platforms to assess participants' reasons for choosing products sweetened with artificial sweeteners, their knowledge and perception of this topic, and whether they would alter their choices with increased knowledge about these non-nutritive sweeteners. A total of 124 participants contributed valuable data to this research.

The study's findings indicate that Dutch consumers have insufficient knowledge about artificial sweeteners and maintaining a healthy diet. Notably, 51% of the respondents expressed their willingness to reduce their consumption of products containing these non-nutritive sweeteners when learning about the potential health risks associated with them.

These research insights can be valuable for customers, food producers, and the government in gaining a better understanding of consumer preferences and choices related to a healthy diet. Specifically, the Dutch government can utilize this information to implement new measures aimed at restricting or prohibiting misleading marketing campaigns, ultimately increasing public's health.

It is recommended that future research should aim to increase the sample size, allowing for a more comprehensive examination of potential correlations within narrower age ranges.

Chapter 1. Introduction

Artificial sweeteners are marketed as a healthier option to sugar and were created as sugar substitutes to help reduce sugar consumption (Warren, 2019). According to Warren (2019), multiple researches demonstrate the potential health advantages associated with the consumption of these sugar alternatives. Research conducted by Jain et al. (2017) explicates that a prudent utilization of artificial sweeteners may help individuals with diabetes in leading a healthy lifestyle without having to compromise on the enjoyment of a sweet taste. However, recent research publications show that artificial sweeteners might have a negative impact on the human body as well and could be associated with obesity (Pearlman et al., 2017). This research is contradicting with the information communicated towards the population, for instance via the Dutch government (Voedingscentrum, n.d.-a). Various advertisements suggest that food sweetened with artificial sweeteners is a better choice. The new candy of Klene, communicated via a commercial on television and social media, implies having a good taste without added sugar (Klene, 2019). Coca-Cola assumes with their advertisement that the Zero Sugar version is as tasty as the regular version (Coca-Cola Nederland, 2016). Both examples suggest that products sweetened with artificial sweeteners are a better alternative, even though they do not state specifically that they are healthier.

Horton et al. (2015) explained that about 2,500 years ago, the first chemically refined sugar appeared. This refined sugar was produced in India and has since spread to other parts of the world. Today's association between sugar and health risks has developed since the significant sugar consumption starting from the mid-17th century and onwards. (Horton et al., 2015)

As stated in a news article of The Week (2017) dieticians have been warning society about fat and cholesterol as food evils that impact the public's health. Currently, a growing number of nutritionists indicate sugar, by an overconsumption of candy, soda, other sweets and processed food, as the real cause of the global health crisis (The Week, 2017).

1.1. Governmental actions to reduce sugar intake

To reduce sugar intake, artificial sweeteners, are used to maintain the sweetness of food (Neascsu & Madar, 2014). According to Voedingscentrum (n.d.-b), all sweeteners used in food products are assigned with an E-number, which indicates it is safe for consumption within the food industry in Europe. The European Food Safety Authority (EFSA) evaluates the safety of sweeteners and determines their eligibility for approval, after which the European Commission assigns them an E-number (Voedingscentrum, n.d.-b).

Population health is an important item within the government's policy in the Netherlands (Ministerie van Algemene Zaken, 2022a). Over the last decades, the government worked on reducing salt, fat and sugar consumption among the population involved collaborating with companies to produce and supply healthier food options (Ministerie van Algemene Zaken, 2022a). In addition to the difficulty faced by the food industry in retaining the desired taste while using natural and clean-label ingredients, as explained by Erickson and Carr (2020), Nestlé and Unilever are two prominent examples of corporations that have been implementing strategies to decrease the levels of sugar, fat, and salt in their products over the past few years. Nestlé has been reducing the amounts of these substances in its food items for some time, as noted on its website (Nestlé, n.d.). Similarly, Unilever has also been taking measures to

decrease the levels of sugar, fat, and salt in its products, as stated on the company's website (Unilever, n.d.).

Besides the responsibility of organizations, people have to make the right food choices as well. Therefore, multiple campaigns have been set up by the Dutch Government to increase knowledge about food, the so-called 'Disc of Five' (Schijf van Vijf in Dutch) is one of these initiatives (Voedingscentrum, n.d.). Based on what a human body needs per day, this platform gives an insight into what to eat, to make sure all necessary nutrients are consumed. Consumption of food products that are not part of the Disc of Five, such as soft drinks and juices, should be limited (Voedingscentrum, n.d.).

Scientists developed a logo called Nutri-Score for the French government (Hercberg et al., 2021). According to Ministerie van Algemene Zaken (2022), some other European countries and large companies have already adopted this logo, and the Dutch government is planning to use it as well. This logo contributes to an easier decision-making when choosing for a healthy food product within a specific category at the supermarket (Hercberg et al., 2021). The highest score within Nutri-Score is A, and food products labelled with this score are a healthier choice (low in salt, sugar and saturated fat) than food products scored with the lowest Nutri-Score of E (Ministerie van Algemene Zaken, 2022).
The Belgian supermarket chain Delhaize (Delhaize, n.d.) labelled corn waffles with Nutri-Score A and Snickers with Nutri-Score E in the snacks category of Belgian and French supermarkets. In this way, consumers can see directly in the supermarket which product is the healthier choice (Ministerie van Algemene Zaken, 2022).

While the government and (independent) organizations such as The Netherlands Nutrition Centre (Voedingscentrum, n.d.-a) try to reduce the intake of salt, saturated fat, and sugar, reducing the sugar intake is not an easy task. Human's love for sweet foods is innate, according to Chakraborty and Das (2019), the preference for sweet taste is natural and the pleasure of eating can be increased with a sweet taste in food.
Despite informing society about the disadvantages of sugar, human intake of sugar in the Netherlands is still too high; according to data from 2018, the average daily sugar consumption of adults in The Netherlands was recorded at 114 grams, which exceeds the recommended daily intake level (National Institute for Public Health and the Environment [RIVM], 2018).

1.2. Health effects of sugar consumption

An article by Harvard Health (2022) indicates that excessive sugar intake by humans contributes to a large number of public health problems. This article explains that in all foods that contain carbohydrates, natural sugars are present and that the consumption of these natural sugars is not the problem, since the human body needs sugar as an energy source. As stated by Harvard Health (2022), the problem with sugar arises when too much sugar is consumed. As indicated in this article, manufacturers add sugars to their products to increase shelf life or improve the taste, including products such as soft drinks, cookies and candy, sugar is also added to products that people may not directly think of, such as bread, soup or cured meats. These factors contribute to the overconsumption of sugar, as mentioned in the previous chapter (Harvard Health, 2022).

Richards (2020) explained, right after the consumption of sugar or within a couple of hours, people can experience a low energy level, a low mood or bloating. In addition to these symptoms, some serious health issues can occur in the long term (Richards, 2020). These include not only the overall known weight gain and obesity but also the potential for individuals

to experience dental problems, acne, diabetes, insulin resistance, cardiovascular diseases, high blood pressure, a higher risk of developing cancer, and accelerated skin ageing (Richards, 2020).

According to Johnson et al. (2017), there is a correlation between the increase in sugar consumption and the rise in obesity and diabetes. This study explains that there is indirect evidence that the production and consumption of honey have led to a rise in obesity in the Old Egyptian Kingdom. Additionally, in the same article, it is mentioned that the physician Sushruta linked the consumption of sugary liquids with obesity and diabetes at the Ganges River Valley in 400 before Christ. Furthermore, during the time of the Dutch East Indies Company, Steven Blankaart, a physician, connected the start of sugar transportation from Java to The Netherlands with the beginning of a rise in obesity and diabetes (Johnson et al., 2017). As indicated in the article by Johnson et al., 2017), there has been an increase in knowledge about the role of sugar in increasing obesity and diabetes which has led to a variety of measures to reduce sugar consumption in the last decade. A correlation can be found between these sugar intake reductions and a stabilization in the obesity and diabetes epidemics (Johnson et al., 2017).

Nowadays, the Dutch government is continuously taking steps to reduce sugar consumption among its citizens (Ministerie van Algemene Zaken, 2022a). In response, food manufacturers are reformulating their products to reduce or eliminate sugar while maintaining sweetness and keeping shelf life through the use of artificial sweeteners as sugar substitutes (Warren, 2019).

1.3. Artificial Sweeteners

The first artificial sweetener, saccharin, which was produced by Constantin Fahlberg in 1885, was a surprising scientific achievement due to its extreme sweetness (Bobde, 2016). This was, according to this article that was published in the Journal of Clinical Diabetology, the primary reason for using artificial sweeteners as a substitute for sugar, as well as the associated consequences. While natural sweeteners have a caloric value (4 kcal per gram), artificial sweeteners have no or a lower amount of calories and are utilized as sugar replacements to maintain the sweetness and shelf life of products while reducing caloric intake. (Bobde, 2016)

According to De La Peña (2010), until the 1930s, saccharin was the only sugar substitute used in the United States, as its consumption was limited to individuals with medical conditions, such as diabetes, who needed to avoid sugar intake. This article also indicates that since the 1950s, cyclamates were introduced to the market and followed up by aspartame in the early 1980s. Nowadays sugar substitutes are important in worldwide markets for all customers who want to reduce sugar intake and maintain a sweet taste (De La Peña, 2010).

De La Peña (2010) explains the three causes for this shift in the usage of artificial sweeteners. According to the source, first, the development of second-generation sweeteners improved the taste of products sweetened with these non-nutritive sweeteners. Second, in the late 20th century, there was an increasing popularity in dieting and consuming products sweetened with sugar substitutes decreases caloric intake. Third, marketing and branding practices have improved, resulting in reaching a broader range of people (De La Peña, 2010).

Various research papers show the benefits of these artificial sweeteners and other research papers describe the disadvantages (Warren, 2019). Agarwal et al. (2016) explain that substituting non-nutritive sweeteners for high-calorie sweeteners can be advantageous in terms of reducing caloric intake and weight management in the short term. This study indicates that after reviewing trials analyzing the impact of non-nutritive sweeteners on weight, it was

determined that a reduction of 220 kcal per day through the use of aspartame could result in a weight loss of 0.2 kg/week over a 12-week period. Long-term data is still needed to indicate the effects for a longer period (Agarwal et al. 2016).

People with diabetes use artificial sweeteners as a substitute for nutritive sweeteners to regulate their carbohydrate and energy consumption (Lohner et al., 2020).

In addition to these advantages, a study by Rios-Leyvraz and Montez (2022) conducted by various studies in obese, overweight and mixed-weight over a generally healthy population worldwide, reveals that high consumption of non-nutritive sweeteners is linked to weight gain, type 2 diabetes, and cardiovascular diseases.

Research by Pepino (2015) describes the metabolic effects of consuming products sweetened with sugar substitutes. This study explains, to control the homeostasis of a human's energy level, certain physiological responses appear in a human's body by establishing a sweet taste in products. Products sweetened with non-nutritive sweeteners trigger these physiological responses but they do not contain any nutritional value to balance the energy level. As a result, it affects the metabolic system (Pepino, 2015).
There is growing evidence of the development of metabolic abnormalities by the substitution of non-nutritive sweeteners for natural sugars (Liauchonak et al., 2019).

The European Food Safety Authority (EFSA) has approved the use of 11 non-nutritive sweeteners in foods and drinks (Safety & Regulation - International Sweeteners Association, 2020). These sweeteners are aspartame (E951), acesulfame-K (E950), cyclamate (E952), saccharin (E954), sucralose (E955), thaumatin (E957), neohesperidine DC (E959), steviol glycosides (E960), neotame (E961), aspartame-acesulfame salt (E962), and advantame (E969).

According to Strawbridge (2020), the response of the human body and brain to these sweeteners is complicated. This article explains that some consumers of products sweetened with artificial sweeteners tend to compensate for the calories that have been saved by the intake of other food products. The frequent use of intense and strong non-nutritive sweeteners, which overstimulate sugar receptors, can lead to limited tolerance for complex tastes, making unsweetened foods less appealing (Strawbridge, 2020). Artificial sweeteners have the potential to break the psychological association between sweetness and caloric intake, which could lead to increased cravings for sweets, a preference for sweet foods over nutritious options, and ultimately weight gain (Strawbridge, 2020).

Non-nutritive sweeteners may even be addictive, which was shown by Lenoir et al. (2007) who found that the intense sweetness of sugar substitutes can produce a stronger reward response than cocaine. Most mammals have developed sweet receptors in ancestral environments, since highly sweetened food and drinks are common in modern societies, human receptors are not adapted to these concentrations (Lenoir et al., 2007). The consumption of highly sweetened products, which may generate a signal of reward in the brain, has the potential to suppress self-control mechanisms that could lead to an addiction to food and drinks sweetened with artificial sweeteners (Lenoir et al., 2007).

1.4.   Consumer knowledge of artificial sweeteners

Wilson et al. (2019) observed a knowledge gap among university students in science and healthcare regarding artificial sweeteners and their impact on health. This article indicated that the researchers assumed that these students would possess more knowledge of non-nutritive

sweeteners compared to the general population. Hence, the relevance of investigating whether knowledge of artificial sweeteners affects consumer decision-making arises, as the lack of awareness about sugar substitutes in one's diet may result in health issues (Wilson et al., 2019). The study revealed that these university students were unable to identify and explain artificial sweeteners listed on food product labels. Due to this knowledge gap and despite having access to information on non-nutritive sweeteners, the general public may find it challenging or almost impossible to make informed choices (Wilson et al., 2019).

In situations where consumers possess insufficient knowledge about the impacts of food items sweetened with artificial sugar, marketing campaigns that insinuate the superiority of their product's healthfulness may exert an influential effect on individuals' decision-making processes (Vukmirovic, 2015). Research by Vukmirovic (2015), indicates a significant association between exposure to food advertising and food choices, particularly through a review that specifically examines television food advertising and its correlation with the consumption of nutrient-poor foods. When individuals who are not familiar with non-nutritive sweeteners are exposed to commercials such as Coca-Cola Zero (Coca-Cola Nederland, 2016) and Klene sugar-free (Klene, 2019), as discussed earlier in this chapter, their decision-making process might be influenced.

Therefore, it could be questioned if consumers make other decisions when possessing knowledge of sugar substitutes. Hence, the main research question of this research is:

What is the impact of knowledge about artificial sweeteners on the choices made by Dutch consumers?

To obtain an answer to the main question, the following sub-questions were formulated:
1. Why do consumers choose for products sweetened with artificial sweeteners?
2. What is the current knowledge and perception about artificial sweeteners among Dutch consumers?
3. To what extent would Dutch citizens make different choices if they had more knowledge about artificial sweeteners?

This research study aims to examine the impact of knowledge regarding artificial sweeteners on the choices made by Dutch consumers. The results of the study are expected to be of significant interest to various stakeholders, including consumers, food producers, regulators, and policymakers in the Netherlands. Specifically, this investigation will provide valuable insights into the current level of knowledge of Dutch consumers about artificial sweeteners and whether possessing such knowledge would influence their food choices.

The findings of this study are anticipated to offer crucial information to stakeholders involved in the promotion of healthy diets and the prevention of diet-related diseases in the Netherlands.

Chapter 2. Materials and Methods

2.1. Materials

As explained in the previous chapter, results from this research indicated if Dutch consumers made a different choice when possessing knowledge about artificial sweeteners. To collect data for answering the sub-questions, an online questionnaire by Google Forms was used. A computer with Internet was necessary to create and spread the questionnaire. The survey was sent via Social Media platforms such as Facebook, Instagram, and LinkedIn. This method of research was chosen because of its uniformity, cost-effectiveness, time efficiency, and the possibility to reach a broader area of respondents (Dudovskiy, n.d.). The data collected in this study was organized objectively to enable generalization of the findings to the entire population of Dutch consumers (Wilson et al., 2021). This research was quantitative and the statistical software JASP was utilized for the purpose of analyzing the collected data (The JASP Team, n.d.).

A minimum number of respondents who filled out the survey was necessary to determine if this research was reliable and valid (Orn, 2021). The population of the Netherlands was 17,236,880 on March 15th, 2023 (Worldometers, 2023). According to CloudResearch (2020), a population size bigger than 100,000 in combination with a 10% margin of error explained that a minimum of 100 respondents was necessary for a statistically valid research.

2.2. Data collection

The questionnaire, which had an English and Dutch version (Appendix 1. Survey – Google Forms), was targeted at Dutch consumers and was sent through Social Media for a period of 10 days. This survey adopted a quantitative approach, employing solely multiple-choice questions divided into four different parts.

In the first part, there were two questions to ensure that the appropriate target audience was reached for the purpose of the study. The questions: "Do you live in The Netherlands?" and "Do you consume products that are sweetened with sugar or sugar substitutes?" served as screening criteria to determine the eligibility of the participant for the study. These questions offered nominal response options, specifically "Yes" or "No". If a participant responded with "No" to either or both of these questions, they were ineligible to participate in the study, and the survey ended. In contrast, if a participant responded with "Yes" to both questions, they proceeded to the second part of the survey.

In the second part, demographic questions helped to understand whether there existed any variations in responses based on the participants' demographic characteristics. Question 3 asked the participants about their gender (which was a nominal variable), and the next question asked them about their age and educational level (ordinal variables). All questions were formatted as multiple-choice options.

In the third part, information was gathered related to the first and second sub-questions. To answer the first sub-question of this research, the following question was asked and provided with multiple-choice options: What are reasons for you to buy products sweetened with artificial sweeteners? As an answer to this question, the respondent could choose answers related to taste, health, and losing weight. This was a multi-select multiple-choice question, which implied that the participant had the possibility to choose more than one option as an answer.

The four questions in the second part of phase three provided the required information to respond to the second sub-question in this study. The first and second questions indicated the knowledge of artificial sweeteners among the respondents, while the third and fourth questions assessed the perception of the respondents towards artificial sweeteners. The first question was a multi-select multiple-choice question. The second, third, and fourth questions within this part were single-select and provided with multiple-choice options.

The first question was: Indicate all products which are part of the "schijf van vijf"? The respondent had to choose between products that are part of the "schijf van vijf" and products that are not. Within the second question: beverages with artificial sweeteners contain fewer calories than beverages with sugar?, the candidate could indicate if the question was true, not true, or if they did not know the answer.

In the third and fourth questions, participants were asked to indicate their perception by selecting answer options such as true, not true, or indicating that they did not know.
- Consuming products sweetened with artificial sweeteners is a good option when you want to lose weight?
- Consuming products sweetened with artificial sweeteners will help me in preventing getting diabetes and cardiovascular diseases?

At the start of part four, participants will be asked to read a small introduction about the health effects of artificial sweeteners as described in the introduction of this study. After this information is given, there will be two final questions asked to the respondents. The first question was a single-select multiple-choice question: "Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?" the answer options indicated whether participants would or would not change their consumption pattern. The second question was a multi-select multiple-choice question: "What are reasons for you, after being informed about the potential health effects, to still buy products sweetened with artificial sweeteners?" respondents could choose between answers related to taste, health, or weight loss.

2.3.   Data analyzation

The collected data from the questionnaire were analyzed using the statistical program JASP to answer the sub-questions and ultimately address the main question of this research. In order to determine the presence of a significant correlation between certain survey questions, the Chi-squared test was employed in JASP to determine the P-value of the two datasets. When the P-value was lower than the threshold of 0.05, the two compared datasets were considered significantly correlated (Pandis, 2016).

Questions 1 and 2 were not included in the data analysis, as they were used as screening criteria for this study. The results of questions 3 to 12 were presented using graphs and tables.

Table 1 presented a mapping of the survey questions and their corresponding sub-questions. Survey question 6 related to the first sub-question, survey questions 7 to 10 answered the second sub-question, and survey questions 11 and 12 were compared to answer the third sub-question.

Sub-Question	Survey Question
1. Why do consumers choose for products sweetened with artificial sweeteners?	Question 6. What are reasons for you to buy products sweetened with artificial sweeteners?
2. What is the current knowledge and perception about artificial sweeteners among Dutch consumers?	Question 7. Indicate all products which are part of the "schijf van vijf"?
	Question 8. Beverages with artificial sweeteners contain fewer calories than beverages with sugar?
	Question 9. Consuming products sweetened with artificial sweeteners is a good option when you want to lose weight?
	Question 10. Consuming products sweetened with artificial sweeteners will help me in preventing getting diabetes and cardiovascular diseases?
3. To what extent would Dutch citizens make different choices if they had more knowledge about artificial sweeteners?	Question 11. Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?
	Question 12. What are reasons for you, after being informed about the potential health effects, to still buy products sweetened with artificial sweeteners?

Questions 3, 4, and 5 (demographical questions) were independent variables that were subjected to statistical analysis to determine their effect on questions 7 through 11, which were dependent variables. To determine if the questions regarding knowledge and perception correlated with the participant's willingness to change their consumption patterns after getting information on the potential health effects of artificial sweeteners, questions 7 and 8 were examined in relation to question 11. Chi-squared tests were employed to investigate the presence of statistically significant correlations within these datasets. Table 2 provided an overview of the statistical tests for the datasets that were analyzed.

In the end, this information combined with the results per survey question assisted in providing a response to the sub-questions and main question of this research.

Table 2. Statistical test per datasets

Datasets		Statistical test
Question 7 : Indicate all products which are part of the "schijf van vijf"?	**Question 3** (Gender)	The Chi-squared test
	Question 4 (Age)	The Chi-squared test
	Question 5 (Educational level)	The Chi-squared test
Question 8 : Beverages with artificial sweeteners contain fewer calories than beverages with sugar?	**Question 3** (Gender)	The Chi-squared test
	Question 4 (Age)	The Chi-squared test
	Question 5 (Educational level)	The Chi-squared test
Question 9 : Consuming products sweetened with artificial sweeteners is a good option when you want to lose weight?	**Question 3** (Gender)	The Chi-squared test
	Question 4 (Age)	The Chi-squared test
	Question 5 (Educational level)	The Chi-squared test
Question 10 : Consuming products sweetened with artificial sweeteners will help me in preventing getting diabetes and cardiovascular diseases?	**Question 3** (Gender)	The Chi-squared test
	Question 4 (Age)	The Chi-squared test
	Question 5 (Educational level)	The Chi-squared test
Question 11 : Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?	**Question 3** (Gender)	The Chi-squared test
	Question 4 (Age)	The Chi-squared test
	Question 5 (Educational level)	The Chi-squared test
	Question 7 (Knowledge Q1)	The Chi-squared test
	Question 8 (Knowledge Q2)	The Chi-squared test

Chapter 3. Results

In this chapter, the findings from the online survey are presented. The chapter begins by providing an overview of the demographic information of the participants. Following this, the results of the survey questions related to the three sub-questions are displayed.

3.1. Demographical results of the participants

In total, 131 persons filled out the survey of which 124 persons met the criteria. 7 persons were excluded because they do not live in the Netherlands and/or do not consumer products sweetened with sugar or sugar substitutes.

Figure 1, shows the demographic data of the respondents, which was gathered through questions 3, 4, and 5 of the survey. The majority of the participants are female (73%), and 27% male. The age category of 18-24 years represents the largest group within this range (37%). Due to a low amount of participants in other categories, the age categories will be merged into 18-34 years (59%), 35-54 years (27%), and 55+ (14%. It is important to note that all participants have received an education, with the majority holding an HBO diploma (43%) followed by MBO (27%), University (18%) and High School (12%).

This information will be utilized in this research to explore potential connections between these demographics and other survey questions. Appendix 4 shows an overview of these demographic data.
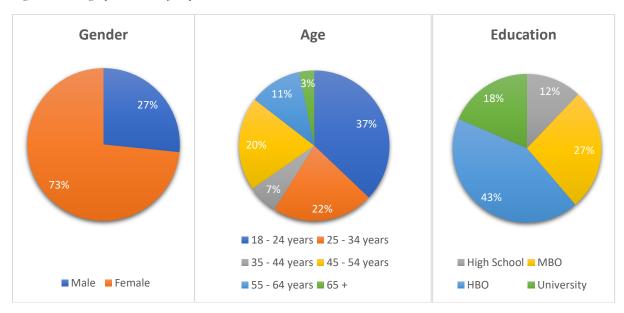
Figure 1. Demographical data of respondents

3.2. Why do consumers choose for products sweetened with artificial sweeteners?

This paragraph is related to the first sub-question of this research. The participants were asked to indicate why they buy products sweetened with artificial sweeteners and the results are shown in figure 2. The participants could select multiple answers.

Many participants (46) choose to buy products that contain artificial sweeteners because they want to reduce the number of calories they consume. On the other hand, 37 participants indicated that they do not buy these products at all. 24 participants indicated buying these

products because they believe it is healthier than products sweetened with sugar. Other reasons for participants to buy these products are: artificial sweeteners have a better taste (13), participants want to lose weight (15), they want to prevent dental issues (8) or they have diabetes (7). Some respondents indicated other reasons (19) as well, such as:

- I never look at the packaging or ingredient list (6)
- Unconscious purchasing (8)
- I try to avoid carbohydrates (1)
- I try to buy as less as possible (3)
- Products sweetened with artificial sweeteners are cheaper or easier to cook (1)
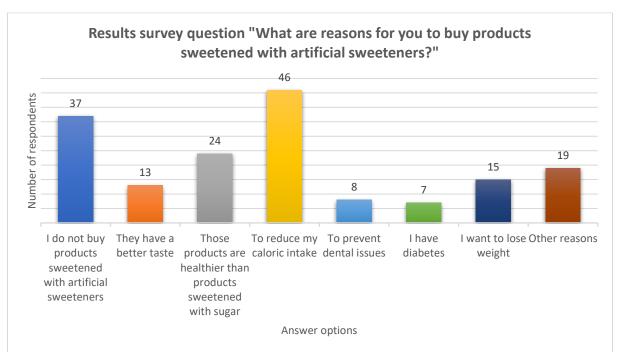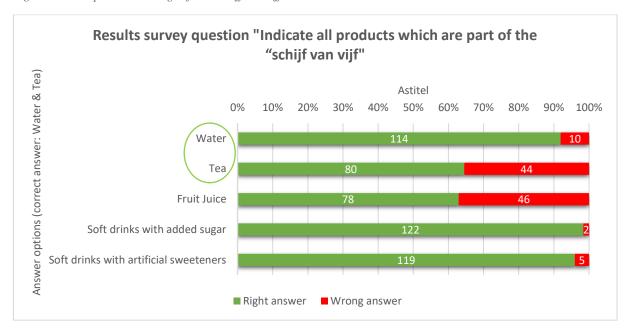
Figure 2. Reasons why participants buy products sweetened with artificial sweeteners.

3.3. What is the current knowledge and perception about artificial sweeteners among Dutch consumers?

This third paragraph relates to the second sub-question of this research. Figure 3 presents the responses provided regarding consumers' knowledge of the "schijf van vijf". Participants had to indicate which products are part of this governmental dietary guideline and the correct answer options for this question were water and tea (Voedingscentrum. n.d.-c). The majority of respondents (114) answered correctly that "water" is part of this guideline, while only 10 participants provided an incorrect answer. When it came to the correct answer "tea," a higher number of mistakes were made. 80 participants provided the correct answer, whereas 44 participants provided an incorrect answer. Fruit juice is not included in the "schijf van vijf" (Voedingscentrum, n.d.-c); 46 participants answered this incorrectly and 78 participants provided the correct answer. Most participants had the correct understanding regarding soft drinks with added sugar (2 wrong answers) and soft drinks with artificial sweeteners (5 wrong answers). Both are not part of the dietary recommendation.

It can be seen that most mistakes were made for the answer options "Fruit Juice" and "Tea", and not soft drinks (with or without artificial sweeteners).

Figure 3. Participants' knowledge of the "schijf van vijf"

Results survey question "Indicate all products which are part of the "schijf van vijf"

Chi-Square tests were used to test for correlations between the knowledge answers and demographic factors (see appendix 5). The calculated test values of participants' answers to question 7 and their demographic values are presented in Table 3.

Table 3. Chi-Square test results of question 7 and participants' demographic factors

Demographical factors		Answer options				
		Water	**Tea**	**Fruit Juice**	**Soft drinks with added sugar**	**Soft drinks with artificial sweeteners**
Gender	X²-value	0.064	1.953	2.499	0.569	0.478
	P-value	0.800	0.162	0.114	0.451	0.489
Age	X²-value	11.153	2.789	2.699	0.740	1.237
	P-value	0.004	0.248	0.259	0.691	0.539
Education	X²-value	2.857	6.625	2.930	2.723	1.085
	P-value	0.414	0.085	0.403	0.436	0.781

A significant correlation was observed between the participants who correctly chose the answer option 'water' and their age, as indicated by the P-value being lower than the threshold of 0.05. The correlation, as shown in Table 4, demonstrates that the younger age group (18-24 years) achieved the highest percentage of correct answers (96%), followed by the 35-54 age group (94%), and the 55+ age group had the lowest score of 72%.

Table 4. Result of participants' age and if they had the right answer option 'water' correct or incorrect

What is your age?	Water		
	Correct	**Incorrect**	**Total**
18 - 34 years	96%	4%	100%
35 - 54 years	94%	6%	100%
55+	72%	28%	100%

No other correlations were found between participants' demographic factors and their answers to question 7.

For question 8, participants were asked about the amount of calories in beverages with artificial sweeteners compared to beverages sweetened with sugar. The majority of the respondents (56%) answered correctly that beverages with artificial sweeteners contain fewer calories, while a smaller group believed they did not contain fewer calories (24%) or did not know the answer (20%) (see Figure 4).
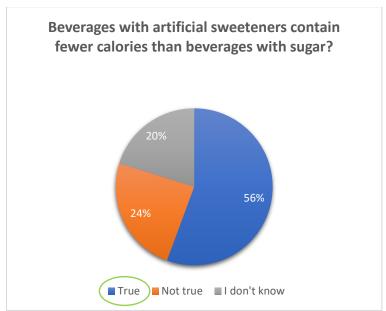
Figure 4. Participants' knowledge on calories in beverages sweetened with artificial sweeteners compared to sugar

To assess the potential correlation between this question and the participants' demographics, a Chi-squared test was performed. Table 5 displays the results of this test and the details of the test can be found in Appendix 5.

Table 5. Chi-Square test results of question 8 and participants' demographic factors

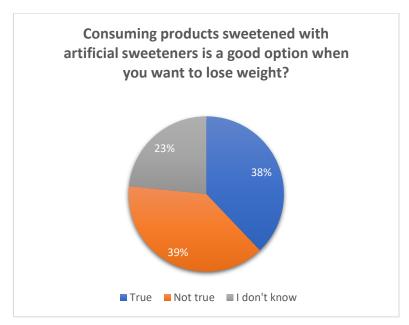| *Demographical factors*		*Results question 8*
Gender	X²-value	1.133
	P-value	0.568
Age	X²-value	12.809
	P-value	0.012
Education	X²-value	5.300
	P-value	0.506

The P-values for gender (0.568) and educational level (0.506) were both above the significance threshold of 0.05, suggesting that no significant correlation was observed. However, in the case of the demographic factor age, the P-value was 0.012, which indicates a significant correlation between age and the question related to consumer knowledge of calories in beverages regarding artificial sweeteners and sugar. This correlation is shown in table 6. Within the age categories, the 35-54 age group displayed the highest level of knowledge in this question, with 76% choosing the answer option 'true'. In contrast, the 55+ age group had the highest percentage of answers marked as 'not true,' accounting for 39%. Interestingly, the age group 18-34 years had the highest percentage of answers in 'I don't know'.

Table 6. Participants' knowledge of the number of calories in beverages with artificial sweeteners and sugar compared to demographical factor age

Age	Beverages with artificial sweeteners contain fewer calories than beverages with sugar?			
	True	**Not true**	**I don't know**	**Total**
18 - 34	49%	22%	29%	100%
35 - 54	76%	21%	3%	100%
55+	44%	39%	17%	100%

For the third question, the candidates were asked about their perception of consuming artificial sweeteners to lose weight (see figure 5). The majority of respondents (39%) thought that sugar substitutes are not a good option when trying to lose weight. 38% of the respondents agreed with the statement and 23% did not have an opinion.

Figure 5. Participants' perception of consuming artificial sweeteners as a good option for losing weight

The Chi-Square test results are presented in table 7. The P-value of the demographical factors gender (0.298) and educational level (0.509) are higher than the threshold of 0.05, therefore a significant correlation cannot be found. The demographical factor age meets exactly the amount of 0.05. Therefore, there could be a significant correlation between age and the candidates' perception of losing weight by consuming artificial sweeteners.

Table 7. Chi-Square test results of question 9 and participants' demographic factors

Demographical factors		*Result question 9*
Gender	X^2-value	2.421
	P-value	0.298
Age	X^2-value	9.478
	P-value	0.05
Education	X^2-value	5.272
	P-value	0.509

While the correlation between question 9 and age as a demographic factor is not particularly strong, there are notable variations in answers across different age categories (see table 8). Among respondents aged 18-34, the majority (38%) indicated that they believe consuming products sweetened with artificial sweeteners is a good option for weight loss ('true'). However, within the 'I don't know' answer option, this age group had the highest response rate (32%).

For the age category 35-54, a similar pattern emerges, but with different response options. Within this group, the highest percentage (48%) chose the 'not true' option, indicating their disbelief in the effectiveness of artificial sweeteners for weight loss. However, within the 'true' option, they had the highest percentage of respondents (42%) selecting it.
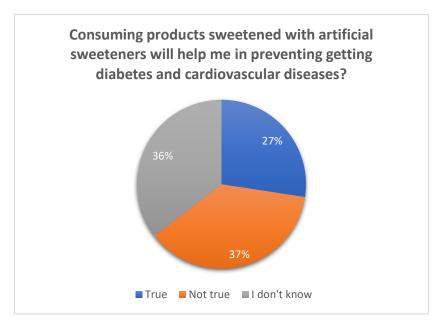
Among those aged 55 and above, the highest percentage of respondents chose 'not true' (56%) both within their age category and within the 'not true' option group.

Table 8. Participants' perception of consuming products sweetened with artificial sweeteners as a good option for losing weight compared to the demographic factor of age

Age	Consuming products sweetened with artificial sweeteners is a good option when you want to lose weight?			Total
	True	**Not true**	**I don't know**	**Total**
18 - 34	38%	30%	32%	100%
35 - 54	42%	48%	9%	100%
55+	28%	56%	17%	100%

When participants were asked the fourth question regarding their opinion on consuming products sweetened with artificial sweeteners rather than sugars as a preventive measure against diabetes or cardiovascular diseases, the results showed that the majority (37%) disagreed with the notion of it being advantageous (see figure 6). A significant number of respondents (36%) indicated uncertainty on the matter, while 27% believed that opting for artificial sweeteners instead of sugar could indeed offer benefits in preventing cardiovascular diseases or diabetes. There has not been a significant correlation found between this question and the demographical factors of participants. The P-values of Gender (0.992), Age (0.349) and Educational level (0.754) are not lower than the threshold of 0.05.

Figure 6. Participants' perception of consuming products sweetened with artificial sweeteners to prevent getting diabetes and cardiovascular diseases

There has not been a significant correlation found between this question and the demographical factors of participants. The P-values, as presented in table 9, of Gender (0.992), Age (0.349) and Educational level (0.754) are not lower than the threshold of 0.05.

Table 9. Chi-Square test results of question 10 and participants' demographic factors

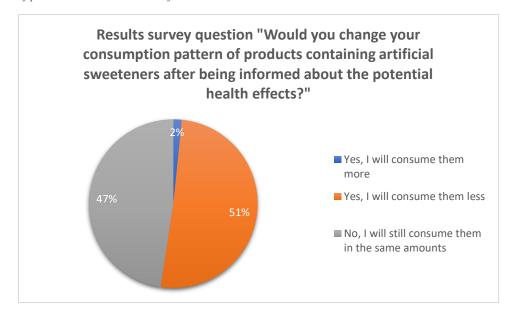| Demographical factors		Result question 10
Gender	X^2-value	0.017
	P-value	0.992
Age	X^2-value	4.448
	P-value	0.349
Education	X^2-value	3.425
	P-value	0.754

3.4. To what extent would Dutch citizens make different choices if they had more knowledge about artificial sweeteners?

After the questions related to knowledge testing on artificial sweeteners among Dutch consumers, participants had to read a small text (appendix 3) containing information on the potential health effects of consuming products sweetened with artificial sweeteners, as explained in the introduction of this research.

The last two questions of the survey relate to the third sub-question of this research. Figure 7 illustrates the results pertaining if the participants would change their consumption pattern after having more knowledge on the potential health effects of consuming products sweetened with artificial sweeteners.

The results show that 51% will consume fewer products containing artificial sweeteners after being informed, while 47% will consume them in the same amounts and 2% will consume them more.

Figure 7. Consumers' opinions on changing their consumption patterns after being informed about the potential health effects of products sweetened with artificial sweeteners.
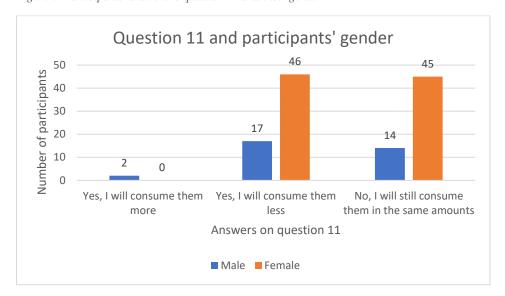

To gain a good understanding of the participant's responses to this question and their demographical information or their answers to the knowledge and perception questions, question 11 is compared to questions 3, 4, 5, 6, 7, 8, 9 and 10.

Figure 8 presents the responses of the participants regarding their willingness to change their consumption patterns of products containing artificial sweeteners after being informed about potential health effects. The data is further broken down by gender, providing insights into any gender-based differences in responses.

This data shows that there is only a small difference for men in the answers "Yes, I will consume them less" (17) and "No, I will still consume them in the same amounts" (14). Among all the people who answered "Yes, I will consume them more" (2), they were all male participants. The differences between the responses of females were even smaller, with 46 indicating a preference for reduced consumption and 45 expressing an intention to consume them in the same amounts.

The Chi-squared test analysis (appendix 5) indicated that there is not a significant correlation between Question 11 and the participants' gender due to the P-value of 0.056 (X^2-value of 5.771), which is higher than the threshold of 0.05.

Figure 8. Participants' answers to question 11 and their gender

The answers to question 11 and the participants' age is illustrated in Figure 9. All participants who expressed a willingness to consume products containing artificial sweeteners more (2) belonged to the age category of 18-34 years old. Within this same age group, the majority (40) stated that they would consume these products in the same amounts, while 31 participants in this category indicated a preference for consuming them less. Interestingly, the distribution of answers in the other two age categories is the opposite. The majority of participants in the age category of 35-54 years (19) and 55+ (13) answered 'Yes, I will consume them less,' against the answer 'No, I will still consume them in the same amounts' where 14 participants were in the age category of 35-54 years and 5 participants in the age category of 55+

The Chi-squared test (Appendix 5) did not find a significant correlation because of the P-value of 0.148 (X^2-value of 6.786), which is higher than the threshold of 0.05.

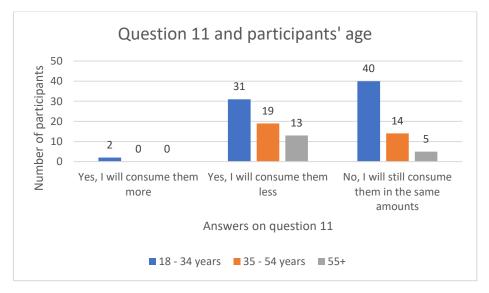*Figure 9. Participants' answers to question 11 and their age*

Figure 10 indicates the responses to question 11 and the participants' educational level. The two participants who expressed a willingness to consume more products containing artificial sweeteners after being informed about the potential health effects had an educational level of

HBO and MBO. As for the other two answer options, participants' education is almost equally divided. Across all educational levels, the number of participants who answered that they would consume them less is almost the same as the answer that they would not change their consumption pattern.

There was not a significant correlation found between question 11 and the participants' educational level because of the P-value of 0.974 (X^2-value of 1.249), which is higher than the threshold of 0.05.
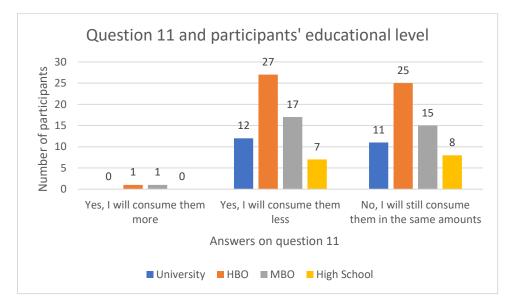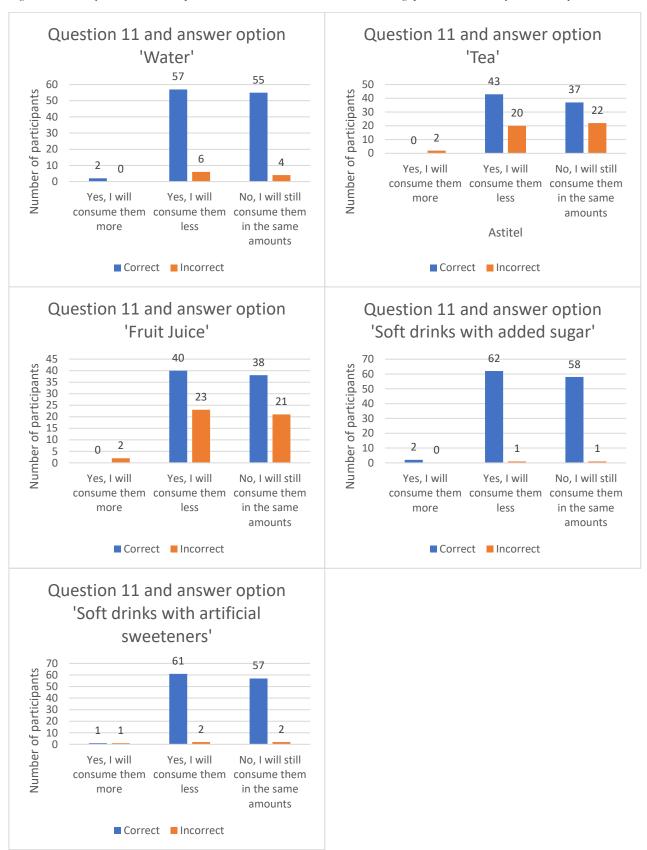
Figure 10. Participants' answers to question 11 and their educational level

The combination of participants' answers to question 7 and question 11 is displayed in Figure 11. Both participants who indicated to increase their consumption of products containing artificial sweeteners after being informed about the potential health effects provided correct answers for the 'water' and 'soft drinks with added sugar' options, while their answers for the 'tea' and 'fruit juice' options were incorrect. Among these two participants, one answered the final option 'soft drinks with artificial sweeteners' correctly, while the other participant answered it incorrectly.

Most participants who expressed a desire to reduce their consumption of products sweetened with artificial sweeteners demonstrated an understanding that 'soft drinks with added sugar' (62) and 'soft drinks with sugar' (61) are not part of the 'schijf van vijf'. There were also only 6 incorrect answers for the option 'water'. However, more mistakes were made for the options 'tea' (20) and 'fruit juice' (23).

All individuals who indicated their intention to continue consuming products sweetened with artificial sweeteners at the same levels made the highest number of mistakes for the answer options 'tea' (22) and 'fruit juice' (21). Only 4 mistakes were made for the answer option 'water'. Interestingly, this group had also the fewest mistakes for the answer options 'soft drinks with added sugar' (1) and 'soft drinks with artificial sweeteners' (2).

Figure 11. Participants' answers to question 11 and their correctness in answering question 7, divided per answer option.

The results of the Chi-square test between question 11 and question 7 are displayed in table 10. There has not been a significant correlation found between question 11 and the answer options 'water', 'tea', 'fruit juice' and 'soft drinks with added sugar' because of the P-values higher than the threshold of 0.05.

Table 10. Chi-Square test results of question 11 and question 7

		Answer options question 7				
		Water	**Tea**	**Fruit Juice**	**Soft drinks with added sugar**	**Soft drinks with artificial sweeteners**
Question 11	X^2-value	0.488	4.105	3.458	0.036	11.104
	P-value	0.784	0.128	0.177	0.982	0.004

The answer option 'soft drinks with artificial sweeteners' did find a significant correlation with question 11 because of the P-value of 0.004 as presented in table 10.
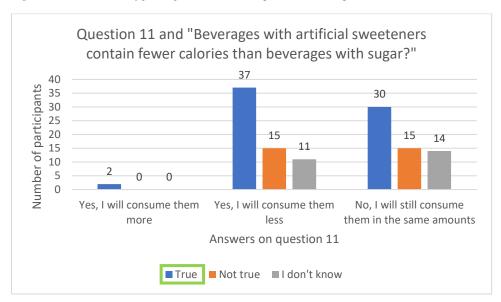
Table 11 presents the participants' responses to question 11 and their answers to question 7 option 'soft drinks with artificial sweeteners'. A correlation has been identified between the answer options 'yes, I will consume them less' and 'no, I will consume them in the same amounts' compared to the percentage of correct answers for question 7, which is 97%. Interestingly, individuals who expressed an increase in consuming products containing artificial sweeteners after being informed about the potential health risks had an equal rate of 50% correct and 50% incorrect responses. This suggests that those who intended to consume more had a higher proportion of mistakes in their responses to this question.

Table 11. Participants' answer to question 11 and answer option 'soft drinks with artificial sweeteners' of question 7

Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?	Question 7 answer option 'soft drinks with artificial sweeteners'		
	Correct	**Incorrect**	**Total**
Yes, I will consume them more	50%	50%	100%
Yes, I will consume them less	97%	3%	100%
No, I will still consume them in the same amounts	97%	3%	100%

In Figure 12, the combined results of the participants' answers to question 8 and question 11 are illustrated. The two people who would consume more products containing artificial sweeteners had the correct answer to the question if beverages with artificial sweeteners contain fewer calories than beverages with sugar. All other people who had the correct answer have been chosen for "Yes, I will consume them less" (37) and "No, I will consume them in the same amounts" (30). An equal distribution is observed among individuals who provided incorrect answers and those who selected these similar options (15 versus 15). Of the people who did not know the answer to question 7, 11 people would consume fewer products containing artificial sweeteners and 14 people would consume them in the same amounts. There is no significant correlation found in the combination of these two questions, as supported by a P-value of 0.629 on the Chi-squared test (Appendix 5). Therefore, the results do not have a surprising outcome.

The results of the final survey question are displayed in Figure 13. It can be observed that there is a significant group that no longer intends to purchase products sweetened with artificial sweeteners after being informed about the potential health effects (44). Additionally, there was a group that expressed their non-purchase of these products, totalling 36 participants. However, there is another group that continues to consume these products due to factors such as better taste (9), calorie reduction (25), or personal reasons not provided as options in the survey (12). The responses to this last option indicated a lack of awareness regarding their purchases (3), no alternatives in the supermarket (1), prices of the products (1), thinking they have a better taste (5) or a general indifference towards what they consume (2).

Figure 13. Participants' reasons for still buying products containing artificial sweeteners after being informed about potential health risks
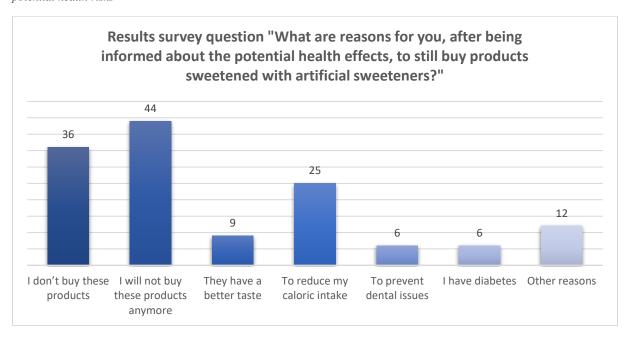
Table 12 presents the combination of participants' responses to the question regarding whether they would change their consumption pattern of products sweetened with artificial sweeteners, as well as their reasons for continuing to purchase these products despite being informed about the potential health risks. The majority of consumer responses are similar among participants who would consume fewer or the same amounts of these products. However, there is an interesting response from one of the two candidates who would consume more of these products. This individual stated, "I will not buy these products anymore." This response contradicts the others, suggesting that the question may not have been read or interpreted correctly.

Table 12. Combination of participants' answers to question 11 and question 12

	Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?		
	Yes, I will consume them more	*Yes, I will consume them less*	*No, I will consume them in the same amounts*
What are reasons for you, after being informed about the potential health effects, to still buy products sweetened with artificial sweeteners? (Multiple answers possible)	It has a better taste	Just in small amounts because products sweetened with sugar are also not health	I already pay attention to a good balance and buy them just sometimes
	I will not buy these products anymore	They are cheaper	My consumption pattern works for me, so I will not change it
		No alternatives at the supermarket	I do not buy them intentional
		I have diabetes	I already knew that artificial sweeteners are not a good option
		I will not buy these products anymore	To reduce my caloric intake
		To reduce my caloric intake	It has a better taste
		To prevent dental issues	I never buy these products
		I did not buy these products	

Chapter 4. Discussion of results

4.1. Method reflection

The main objective of this research was to gain a better understanding of whether more knowledge about artificial sweeteners would impact the consumption choices of Dutch consumers.

A total of 131 individuals participated in the survey, out of which 124 met the criteria. This suggests that the research can be considered statistically valid, as it met the required sample size of 100 respondents (ClaudResearch, 2020). Although the study is deemed statistically valid, the number of participants is relatively low, particularly due to the larger number of distinct age categories. As a result, it was necessary to merge certain categories to ensure proper data analysis.

Choosing Google Forms for creating and distributing the questionnaire has proven to be an excellent decision due to its user-friendly interface for survey creation and the ease with which participants can complete it. The link to the questionnaire was shared on various social media platforms including Facebook, Instagram, and LinkedIn, directing candidates directly to the Google Forms page. The utilization of these Social Media platforms has proven to be effective, as the required number of respondents was successfully achieved within the 10-day period. The program JASP has also demonstrated its effectiveness due to its user-friendly and time-efficient approach in conducting the analysis of the questionnaire results.

The majority of respondents who participated in the questionnaire were women, accounting for 73% of the total. It is important to note that the survey was not intentionally targeted towards women. Since the questionnaire was distributed from an individual's account, it is possible that the connections and network of that person are predominantly with women rather than men. This poses a risk when using personal social media accounts instead of utilizing sponsored or paid messages to ensure a more diverse respondent pool. The same observation applies to the age categories. Although the participants' ages varied, 37% of the candidates fell into the 18-24 age group, and 22% belonged to the 25-34 age group. Since these two groups were combined into a single category, namely 18-34 years, the total percentage of participants in this age group amounted to 59%. Regarding the third demographic characteristic of the participants, a similar discovery emerged. A majority of 43% of the respondents possessed an HBO degree. Future research could be improved by distributing the questionnaire through Social Media using paid advertisements. This approach could help eliminate the potential for unintentional targeting that may occur when relying solely on personal social media accounts.

The screening criteria, consisting of Question 1 and Question 2, have proven to be efficient and effective in determining whether an individual is suitable for this research. This also applies to the demographic questions regarding gender, age, and educational level. Despite merging the age categories due to the participant count, the exploration of diversity and distribution among the participants proved to be an interesting variable during the data analysis process.

For future reference, there is room for improvement in certain questions within the survey. Particularly in question 6 (What are reasons for you to buy products sweetened with artificial sweeteners?), participants were provided with multiple predefined answer options to choose from or the opportunity to provide their own reasons. Considering the intriguing answers provided by participants, it could be questioned whether it would have been better to have the entire question open-ended without answer options. This approach would have allowed candidates to express their own opinions and engage in independent thinking, without

potentially being influenced by the provided answers. Question 7 (Indicate all products that are part of the "schijf van vijf") could also be improved for future research. While this question provides an interesting insight into the participants' knowledge, it becomes challenging to determine whether they truly understand a healthy lifestyle and the "schijf van vijf". This is due to the option for participants to select multiple answers. For instance, if a participant chooses 'water, tea, and fruit juice,' two out of the three answers are correct, with only one mistake. Alternatively, if a participant selects only 'water,' they would be missing one of the answers. Therefore, an improvement for future surveys would be to provide a list of options, including one or multiple products, and allow participants to choose only one answer. This approach would encourage participants to make a more conscious choice and provide a clearer understanding of their knowledge of the "schijf van vijf". A third improvement in the questionnaire could be made for question 11 (Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?). In this question, the majority of answers were 'Yes, I will consume them less' and 'No, I will still consume them in the same amounts.' However, two participants indicated that they would actually consume more products containing artificial sweeteners after receiving the information. Afterwards, there may be a potential lack of clarity in the question-and-answer options for the participants. One of the two participants who indicated increasing their consumption had a contradicting response in question 12, as shown in Table 12 of the results, where this person stated 'I will not buy these products anymore.' Therefore, for future research, an improvement can be made to question 11 and its answer options to ensure greater clarity. The last improvement, regarding the questionnaire, for future research could be made at question 12 (What are reasons for you, after being informed about the potential health effects, to still buy products sweetened with artificial sweeteners?). This improvement would mirror the suggested enhancement for question 6. The question would have been more valuable if participants were encouraged to express their opinions without the potential influence of provided answer options.

4.2. Why do consumers choose for products sweetened with artificial sweeteners?

Participants in this research were requested to provide their reasons for purchasing products sweetened with artificial sweeteners. The majority of respondents indicated that they buy these products because it helps to reduce their calorie intake compared to products sweetened with sugar. This perception among participants aligns with the findings of Agarwal et al. (2016), as mentioned in Chapter 1, where it was explained that artificial sweeteners can be advantageous in terms of reducing calorie intake and assisting in weight management. Another reason for participants to choose for products sweetened with artificial sweeteners is that they have diabetes. Consuming artificial sweeteners as a substitute for sugar, is according to research by Jain et al. (2017) and Lohner et al. (2020), a viable option for individuals with diabetes to enjoy a sweet taste without compromising their health.

Participants have also mentioned buying products sweetened with artificial sweeteners because they believe these products are healthier than those sweetened with sugar. However, some researchers present a contrasting perspective to this perception Research by Rioz-Leyvraz and Montez (2022), as stated in the chapter Introduction of this study, explained the opposite effect of consuming artificial sweeteners as a substitute for sugar. Their research indicated a link between non-nutritive sweeteners and weight gain, type 2 diabetes, and cardiovascular diseases.

Some participants expressed a preference for the taste of artificial sweeteners. Others believe that consuming these sweeteners can help prevent dental issues. Additionally, some participants

mentioned that they do not pay attention to the packaging of products or unknowingly purchase items containing artificial sweeteners.

The diverse outcomes of this sub-question are of interest to various stakeholders engaged in promoting healthy diets, notably the government, which plays a vital role in preventing diet-related diseases within Dutch society. Furthermore, food producers are also interested in the results of this sub-question as it provides insights into consumer preferences, enabling them to enhance existing products or develop new food items that align with consumer desires.

4.3. What is the current knowledge and perception about artificial sweeteners among Dutch consumers?

To address the second sub-question of this research, participants were surveyed regarding their knowledge and perception of artificial sweeteners. A notable finding was that a certain number of individuals were unaware that "tea" is considered part of the "schijf van vijf" while "fruit juice" is not. One possible explanation could be that individuals may not possess sufficient knowledge about healthy food products. For instance, the term "Fruit Juice" may sound healthy because it is widely recognized that consuming fruit is beneficial for a person's health. However, the actual amount of fruit used to produce a single glass of fruit juice can be considerably high. As a result, consuming a glass of fruit juice can lead to an excessive intake of fruit sugars, which is why it may not be considered a healthy option. Another explanation could be that consumers find packaging and marketing techniques regarding tea and fruit juices confusing. These two reasons, when combined, are further supported by the research conducted by Vukmirovic (2015), as discussed in the Introduction chapter. The research highlighted that consumers with insufficient knowledge about the impact of food may be more easily influenced in their decision-making when exposed to marketing campaigns.

However, the majority of people demonstrated an understanding that soft drinks are not included in the "schijf van vijf". It is interesting to observe that consumers are aware of the fact that these products are not part of the "schijf van vijf", particularly considering the efforts made by the Dutch Government to inform society through this platform and promote making informed choices while limiting the consumption of food products outside the "schijf van vijf". This is outlined in the Introduction chapter of this research (Voedingscentrum, n.d.).

These findings are of particular interest to stakeholders, especially the Dutch Government, as they aim to promote healthy eating and raise awareness among individuals. The "schijf van vijf" serves as a helpful tool in facilitating healthier food choices for the population. Therefore, it would be of interest to this stakeholder to understand that individuals are not fully aware of the products included in the "schijf van vijf" tool.

A significant correlation has been identified between the correct or incorrect answers of participants to the 'water' answer option in question 7 and their demographic factor of age. The findings indicate that younger participants exhibited a better understanding that water is included in the "schijf van vijf". Conversely, older participants displayed a higher degree of unawareness regarding the inclusion of water in the guidelines.
Regarding the other analyses conducted between participants' demographics and their knowledge of the "schijf van vijf," no significant correlation was found.

Participants were questioned about their knowledge of whether artificial sweeteners have fewer calories compared to sugar-sweetened beverages. Among all participants, 56% provided the correct answer to this question. This finding is interesting because all participants could have

been aware of this answer since nutritional values are displayed on food packaging. This raises the question of whether customers truly understand the packaging and the nutritional information presented, or if they simply overlook it (what has been discussed in the results of sub-question 1). This is especially noteworthy considering the study conducted by Wilson et al. (2019), which revealed that even university students with backgrounds in science and healthcare struggled to identify and explain food packaging labels. This information holds value for various stakeholders, including the government, food producers, regulators, and policymakers, as it suggests the need for alternative approaches to raising customer awareness if nutrition and food labels prove challenging for individuals to comprehend. A significant correlation was found between this question and the participants' age groups. Notably, a considerable number of individuals in the 18-34 years and 55+ age categories either answered incorrectly or did not know the answer, whereas the 35-54 age group exhibited a higher proportion of correct answers. There were no correlations found between this question and the other demographical variables.

The number of people who believed that consuming products sweetened with artificial sweeteners is a favourable option for weight management is nearly equal to those who disagreed. There is no definitive right or wrong answer to this question due to multiple factors that can impact weight management. Agarwal et al. (2016) suggest that sugar substitutes can have short-term benefits for weight management. However, research by Strawbridge (2020) indicates that individuals may also tend to compensate for the reduced calorie intake or experience increased cravings for sweets, which can affect their weight management efforts. New information has been released by The World Health Organization (2023a), which recommends against the use of artificial sweeteners for body weight control. This updated guideline clarifies that non-nutritive sweeteners are not effective in the long-term reduction of body fat.

There is a significant correlation found between this question and the participant's age. The P-value of 0.05 is similar to the threshold of 0.05, which means that the evidence is not strong but it is still called significant. Among the different answer options of 'true', 'not true', and 'I don't know', the age category of 18-34 years had the highest percentage of responses indicating 'I don't know'. In contrast, the age category of 35-44 years held the belief that consuming these products is advantageous for weight loss. Conversely, the 55+ age category disagreed with this statement. The other demographical variables did not present a significant correlation with this question.

The perception of consumers regarding whether consuming products sweetened with artificial sweeteners helps in preventing diabetes and cardiovascular diseases showed a majority of 36% who indicated that they did not know the answer. This is an interesting finding because there is not a right or wrong answer yet. Multiple research studies present different outcomes, leading to customer uncertainty. De La Peña (2010) explained that artificial sweeteners were initially intended for individuals with diabetes to control their blood sugar levels. On the other hand, the study by Richards (2020) indicates that long-term sugar consumption can contribute to the development of diabetes and cardiovascular diseases. However, research conducted by Rios-Leyvraz and Montez (2022), as well as Pepino (2015) and Liauchonak et al. (2019), has linked artificial sweeteners to an increased risk of type 2 diabetes and cardiovascular diseases. This is further supported by the new guidelines of The World Health Organization (2023a), which suggest potential effects, such as an increased risk of cardiovascular diseases and type 2 diabetes, associated with long-term use of artificial sweeteners. The answers to this question,

when compared to the demographic factors of the participants, did not reveal significant correlations.

4.4. To what extent would Dutch citizens make different choices if they had more knowledge about artificial sweeteners?

An interesting discovery was found when participants were questioned about their willingness to modify their consumption patterns of products containing artificial sweeteners after being informed about the potential health effects. 51% of the participants indicated reducing their consumption of products containing artificial sweeteners because of the potential health effects, while 47% indicated that they would continue consuming them in the same amounts. These findings are particularly interesting when considering the research conducted by Vukmirovic (2015), which indicates that in situations where consumers possess insufficient knowledge about the impacts of food items sweetened with artificial sweeteners, marketing campaigns may have an influential effect on a person's decision-making. This information is particularly valuable for the government. If people lack awareness of the potential health effects of consuming these products, it is crucial to prevent marketing efforts from influencing their decision-making. Therefore, there are various possible solutions, such as providing people with accurate information or implementing changes to rules and regulations concerning the marketing of these products.

The Chi-Squared test conducted between this question and the demographic variables did not find a significant correlation. A correlation has been found between this question and the results of the answer option 'Soft drinks with artificial sweeteners' of question 7. Consumers who expressed a willingness to increase their consumption of products sweetened with artificial sweeteners after being informed about potential health risks demonstrated a lesser understanding that soft drinks sweetened with artificial sweeteners are not included in the 'schijf van vijf'. Participants who indicated a decrease in consumption of products sweetened with artificial sweeteners or those who intended to consume them in the same amounts exhibited a higher percentage of correct answers. The other tests between this question and question 8 did not show a significant correlation.

The last question of the survey asked about the reasons why participants continue to purchase products sweetened with artificial sweeteners, despite being informed about the potential health effects. In addition to the main response of not buying these products (anymore), 25 participants expressed their intention to continue consuming them in order to reduce their caloric intake.

Chapter 5. Conclusions and recommendations

5.1. Conclusions

Various studies have highlighted the challenges of making healthy food choices and the impact of external factors on consumers' decision-making when they possess insufficient knowledge. This research paper provides insights into the knowledge of Dutch consumers regarding artificial sweeteners and examines whether their awareness influences their decision-making and choices.

Within this research, it has been established that consumers primarily opt for products sweetened with artificial sweeteners for reasons such as calorie reduction, weight loss, or the perception of consuming a healthier alternative compared to food and drinks sweetened with sugar.

Based on the findings, it can be concluded that Dutch consumers possess insufficient knowledge regarding artificial sweeteners and maintaining a healthy diet. Consequently, they are more susceptible to the influence of marketing campaigns promoting food products that may not genuinely align with healthy choices.

There is also a majority of customers who would decrease their consumption of products sweetened with artificial sweeteners after gaining more knowledge about potential health risks.

This means, regarding the main question addressed in this research, it can be concluded that there is insufficient knowledge about artificial sweeteners among Dutch customers. Furthermore, customers would make different food choices when they possess an awareness of the potential health effects associated with consuming products sweetened with artificial sweeteners.

5.2. Recommendations

The results of this research are of interest to various stakeholders, including consumers, food producers, regulators, and policymakers in the Netherlands. These findings contribute to a better understanding of the importance for customers of having knowledge about artificial sweeteners in the decision-making process of customers. To translate the insights gained from this research into actionable steps, a set of recommendations can be proposed for these stakeholders, categorized as short-term and long-term recommendations.

5.2.1. Short-term recommendations

In the short term, customers can benefit from dedicating more time to acquiring knowledge about a healthy diet, including becoming fully aware of the products they purchase.

The Dutch government could initiate new or improved current marketing campaigns aimed at enhancing customers' knowledge of healthy diets.

5.2.2. Long-term recommendations

In the long term, decent education on healthy diets should be implemented in Dutch Primary and High Schools. In this way, people are aware of healthy food from a young age.

Simultaneously, the government should take measures to restrict or prohibit marketing campaigns that disseminate misleading information about a healthy diet. This process could take months or even years because of multiple laws and regulations. In this way, Dutch consumers will be protected against misleading marketing campaigns on food products that might not be as healthy as expected.

Additionally, food producers should prioritize the development of packaging that is more comprehensible to customers, while also being transparent and truthful in their marketing campaigns regarding product ingredients and their impact on human health.

5.2.3. Follow-up research

Despite providing interesting insights into customer knowledge, perceptions, and choices regarding products containing artificial sweeteners, further research could be conducted to expand upon the results and gain a deeper understanding.

In this study, a total of 124 participants provided valuable data. However, this sample size was not sufficient to proceed with the predetermined age categories. To ensure a robust analysis, the age categories had to be merged from six to three.

Significant correlations were found between certain questions and the age categories in this research. Therefore, conducting further research with a larger number of participants would be intriguing to explore potential correlations within narrower age ranges.

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Appendices

1. Survey – Google Forms – English version

<u>Introduction of who I am</u>

My name is Jill Holtkuile and I am an International Food Business student at the Aeres University of Applied Sciences. My graduation project involves conducting research on the level of knowledge regarding artificial sweeteners among Dutch consumers and the impact of this knowledge on their decision-making processes.

Part 1.

<u>Question 1. Do you live in The Netherlands?</u>
- Yes   → Continue with question 2.
- No   → Survey ends

<u>Question 2. Do you consume products that are sweetened with sugar or sugar substitutes?</u>
- Yes   → Continue with question 3.
- No   → Survey ends

Part 2.

<u>Question 3. What is your gender?</u>
- Male
- Female
- Other

<u>Question 4. What is your age?</u>
- 18 – 24 years
- 25 – 34 years
- 35 – 44 years
- 45 – 54 years
- 55 – 64 years
- 65+

<u>Question 5. What is the highest level of education you have achieved?</u>
- No diploma
- Primary school
- High School
- MBO
- HBO
- University

Part 3.

<u>Question 6. What are reasons for you to buy products sweetened with artificial sweeteners?</u> (Multiple answers possible)
- I do not buy products sweetened with artificial sweeteners
- They have a better taste
- Those products are healthier than products sweetened with sugar
- To reduce my caloric intake
- To prevent dental issues
- I have diabetes
- I want to lose weight
- Other reasons…..

Question 7. Indicate all products which are part of the "schijf van vijf"? (Multiple answers possible)
- Water
- Tea
- Fruit Juice
- Soft drinks with added sugar
- Soft drinks with artificial sweeteners

Question 8. Beverages with artificial sweeteners contain fewer calories than beverages with sugar?
- True
- Not true
- I don't know

Question 9. Consuming products sweetened with artificial sweeteners is a good option when you want to lose weight?
- True
- Not true
- I don't know

Question 10. Consuming products sweetened with artificial sweeteners will help me in preventing getting diabetes and cardiovascular diseases?
- True
- Not true
- I don't know

Part 4.

Background information on potential health effects of artificial sweeteners

Question 11. Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?
- Yes, I will consume them less
- Yes, I will consume them more
- No, I will still consume them in the same amounts

Question 12. What are reasons for you, after being informed about the potential health effects, to still buy products sweetened with artificial sweeteners? (Multiple answers possible)
- I don't buy these products
- I will not buy these products anymore
- They have a better taste
- To reduce my caloric intake
- To prevent dental issues
- I have diabetes
- Other reasons.....

2. Survey – Google Forms – Dutch version

<u>Introductie over mijzelf</u>
Mijn naam is Jill Holtkuile en ik studeer International Food Business aan de Aeres Hogeschool. Voor mijn afstudeerproject doe ik onderzoek naar de kennis over suikervervangers onder Nederlandse consumenten en de impact van deze kennis op het maken van keuzes.

Deel 1.

<u>Vraag 1. Woon je in Nederland?</u>
- Ja   → Ga door naar vraag 2.
- Nee   → Einde van het onderzoek

<u>Vraag 2. Consumeer je producten die gezoet zijn met suiker of kunstmatig zoetstoffen?</u>
- Ja   → Ga door naar vraag 3.
- Nee   → Einde van het onderzoek

Deel 2.

<u>Vraag 3. Wat is je geslacht?</u>
- Man
- Vrouw
- Anders

<u>Vraag 4. Wat is je leeftijd?</u>
- 18 – 24 jaar
- 25 – 34 jaar
- 35 – 44 jaar
- 45 – 54 jaar
- 55 – 64 jaar
- 65+

<u>Vraag 5. Wat is het hoogste opleidingsniveau dat je hebt voltooid?</u>
- Geen diploma
- Basisonderwijs
- Middelbaar onderwijs
- MBO
- HBO
- Universiteit

Deel 3.

<u>Vraag 6. Wat zijn redenen voor jou om producten gezoet met kunstmatige zoetstoffen te kopen? (Meerdere antwoorden mogelijk)</u>
- Ik koop geen producten met zoetstoffen
- Het heeft een betere smaak
- Deze producten zijn gezonder dan producten gezoet met suiker
- Om mijn calorie inname te verlagen
- Om gebitsproblemen te voorkomen
- Ik heb diabetes
- Ik wil gewicht verliezen
- Andere redenen…

Vraag 7. Welke producten zijn onderdeel van de "schijf van vijf"? (Meerdere antwoorden mogelijk)
- Water
- Thee
- Fruitsap
- Frisdrank gezoet met suiker
- Frisdrank gezoet met zoetstoffen

Vraag 8. Dranken gezoet met kunstmatige zoetstoffen bevatten minder calorieën dan dranken gezoet met suiker?
- Waar
- Niet waar
- Ik weet het niet

Vraag 9. Het consumeren van producten gezoet met kunstmatig zoetstoffen is een goede optie als je gewicht wilt verliezen?
- Waar
- Niet waar
- Ik weet het niet

Vraag 10. Het consumeren van producten gezoet met kunstmatige zoetstoffen kan helpen bij het voorkomen van het ontwikkelen van diabetes en hart- en vaatziekten?
- Waar
- Niet waar
- Ik weet het niet

Deel 4.

Achtergrondinformatie over mogelijke gezondheidsrisico's van zoetstoffen.

Vraag 11. Zou je je consumptiepatroon van producten met kunstmatige zoetstoffen veranderen nadat je zojuist bent geïnformeerd over de mogelijke gezondheidseffecten?
- Yes, I will consume them less
- Yes, I will consume them more
- No, I will still consume them in the same amounts

Vraag 12. Wat zouden redenen voor jou zijn, nadat je bent geïnformeerd over de mogelijke gezondheidseffecten, om nog steeds producten te kopen die gezoet zijn met kunstmatige zoetstoffen? (Meerdere antwoorden mogelijk)
- Ik kocht deze producten niet
- Ik koop deze producten niet meer nadat ik deze informatie heb gekregen
- Het heeft een betere smaak
- Om mijn calorie inname te verlagen
- Om gebitsproblemen te voorkomen
- Ik heb diabetes
- Andere redenen…

3. Information text survey

Information participants received during the survey. Information is in the Dutch language since the survey was send to candidates in The Netherlands.

In het verleden hebben verschillende onderzoeken de positieve effecten van kunstmatige zoetstoffen aangekaart. Nieuwe studies laten echter zien dat deze zoetstoffen mogelijk ook nadelige effecten kunnen hebben. Een wetenschappelijke studie uit 2022 laat zien dat een hoge consumptie van producten gezoet met kunstmatige zoetstoffen mogelijk gelinkt is aan gewichtstoename, diabetes type 2 en hart- en vaatziekten. Verschillende recente onderzoeken laten een effect op je metabolisme zien wanneer je een product consumeert wat gezoet is door kunstmatige zoetstoffen.

Wat er gebeurt: Je lichaam wilt altijd graag in balans zijn. Wanneer je eet, worden er stoffen aangemaakt om je suikerniveau op peil te houden. Andersom: wanneer je suikerniveau te laag is, krijg je een hongergevoel zodat je gaat eten.

Op het moment dat je een product consumeert wat gezoet is met kunstmatige zoetstoffen, houd je je hersenen eigenlijk voor de gek. Zij denken namelijk dat deze zoete stof voedingswaarden bevat zoals suiker bijvoorbeeld wel heeft. Hierdoor worden er processen in je lichaam in gang gezet om deze 'voedingswaarden' af te breken / om te zetten in energie. Doordat je helemaal geen voedingswaarden hebt geconsumeerd, kan er ook niks afgebroken/omgezet worden in je lichaam. Dit zorgt ervoor dat je lichaam een overschot aan deze afbreek/omzet stoffen aanmaakt, je bloedsuikerspiegel naar beneden gaat en jij een hongergevoel krijgt.

Wanneer je niet de intentie hebt om opnieuw wat te eten/drinken (met voedingswaarden), kan dit structureel zorgen voor een onbalans in je metabolisme. Op het moment dat je je hier niet van bewust bent, kan het er daardoor ook voor zorgen dat je wel (ongezond) gaat eten/drinken/snacken en hierdoor juist in gewicht aankomt.

4. Demographical results

What is your age?	What is your gender?	What is the highest level of education you have achieved?				Total
		High School	MBO	HBO	University	
18 - 24	Male	3	2	4	4	13
	Female	6	6	15	6	33
	Total	9	8	19	10	46
25 - 34	Male	1	2	6	2	11
	Female	0	3	8	5	16
	Total	1	5	14	7	27
35 - 44	Male	0	0	2	0	2
	Female	1	1	2	2	6
	Total	1	1	4	2	8
45 - 54	Male	0	0	2	1	3
	Female	0	9	10	3	22
	Total	0	9	12	4	25
55 - 64	Male	0	2	1	0	3
	Female	2	8	1	0	11
	Total	2	10	2	0	14
65 +	Male	1	0	0	0	1
	Female	1	0	2	0	3
	Total	2	0	2	0	4
Total	Male	5	6	15	7	33
	Female	10	27	38	16	91
	Total	15	33	53	23	124

5. Statistical tests – JASP results

Chi-squared tests : Question 7 versus demographical factors

- **Question 7 : Indicate all products which are part of the "schijf van vijf"?**
- **Question 3 : Demographical factor Gender**

Contingency Tables

What is your gender?		Water		
		Correct	**Incorrect**	**Total**
Female	Count	84.000	7.000	91.000
	Expected count	83.661	7.339	91.000
Male	Count	30.000	3.000	33.000
	Expected count	30.339	2.661	33.000
Total	Count	114.000	10.000	124.000
	Expected count	114.000	10.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	0.064	1	0.800
N	124		

Contingency Tables

What is your gender?		Tea		
		Correct	**Incorrect**	**Total**
Female	Count	62.000	29.000	91.000
	Expected count	58.710	32.290	91.000
Male	Count	18.000	15.000	33.000
	Expected count	21.290	11.710	33.000
Total	Count	80.000	44.000	124.000
	Expected count	80.000	44.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	1.953	1	0.162
N	124		

Contingency Tables

| What is your gender? | | Fruit Juice | | |
		Correct	Incorrect	Total
Female	Count	61.000	30.000	91.000
	Expected count	57.242	33.758	91.000
Male	Count	17.000	16.000	33.000
	Expected count	20.758	12.242	33.000
Total	Count	78.000	46.000	124.000
	Expected count	78.000	46.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	2.499	1	0.114
N	124		

Contingency Tables

| What is your gender? | | Soft drinks with added sugar | | |
		Correct	Incorrect	Total
Female	Count	90.000	1.000	91.000
	Expected count	89.532	1.468	91.000
Male	Count	32.000	1.000	33.000
	Expected count	32.468	0.532	33.000
Total	Count	122.000	2.000	124.000
	Expected count	122.000	2.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	0.569	1	0.451
N	124		

Contingency Tables

What is your gender?		Soft drinks with artificial sweeteners		
		Correct	**Incorrect**	**Total**
Female	Count	88.000	3.000	91.000
	Expected count	87.331	3.669	91.000
Male	Count	31.000	2.000	33.000
	Expected count	31.669	1.331	33.000
Total	Count	119.000	5.000	124.000
	Expected count	119.000	5.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	0.478	1	0.489
N	124		

❖ Question 7 : Indicate all products which are part of the "schijf van vijf"?
❖ Question 4 : Demographical factor Age

Contingency Tables

What is your age?		Water		Total
		Correct	Incorrect	
18 - 34 years	Count	70.000	3.000	73.000
	Expected count	67.113	5.887	73.000
35 - 54 years	Count	31.000	2.000	33.000
	Expected count	30.339	2.661	33.000
55+	Count	13.000	5.000	18.000
	Expected count	16.548	1.452	18.000
Total	Count	114.000	10.000	124.000
	Expected count	114.000	10.000	124.000

Chi-Squared Tests

	Value	df	p
X²	11.153	2	0.004
N	124		

Contingency Tables

What is your age?		Tea		Total
		Correct	Incorrect	
18 - 34 years	Count	51.000	22.000	73.000
	Expected count	47.097	25.903	73.000
35 - 54 years	Count	20.000	13.000	33.000
	Expected count	21.290	11.710	33.000
55+	Count	9.000	9.000	18.000
	Expected count	11.613	6.387	18.000
Total	Count	80.000	44.000	124.000
	Expected count	80.000	44.000	124.000

Chi-Squared Tests

	Value	df	p
X²	2.789	2	0.248
N	124		

Contingency Tables

What is your age?		Fruit Juice		
		Correct	Incorrect	Total
18 - 34 years	Count	45.000	28.000	73.000
	Expected count	45.919	27.081	73.000
35 - 54 years	Count	24.000	9.000	33.000
	Expected count	20.758	12.242	33.000
55+	Count	9.000	9.000	18.000
	Expected count	11.323	6.677	18.000
Total	Count	78.000	46.000	124.000
	Expected count	78.000	46.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	2.699	2	0.259
N	124		

Contingency Tables

What is your age?		Soft drinks with added sugar		
		Correct	Incorrect	Total
18 - 34 years	Count	72.000	1.000	73.000
	Expected count	71.823	1.177	73.000
35 - 54 years	Count	32.000	1.000	33.000
	Expected count	32.468	0.532	33.000
55+	Count	18.000	0.000	18.000
	Expected count	17.710	0.290	18.000
Total	Count	122.000	2.000	124.000
	Expected count	122.000	2.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	0.740	2	0.691
N	124		

Contingency Tables

What is your age?		Soft drinks with artificial sweeteners		
		Correct	**Incorrect**	**Total**
18 - 34 years	Count	69.000	4.000	73.000
	Expected count	70.056	2.944	73.000
35 - 54 years	Count	32.000	1.000	33.000
	Expected count	31.669	1.331	33.000
55+	Count	18.000	0.000	18.000
	Expected count	17.274	0.726	18.000
Total	Count	119.000	5.000	124.000
	Expected count	119.000	5.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	1.237	2	0.539
N	124		

➕ Question 7 : Indicate all products which are part of the "schijf van vijf"?
➕ Question 5 : Demographical factor Educational level

Contingency Tables

What is the highest level of education you have achieved?		Water		
		Correct	**Incorrect**	**Total**
HBO	Count	51.000	2.000	53.000
	Expected count	48.726	4.274	53.000
High School	Count	14.000	1.000	15.000
	Expected count	13.790	1.210	15.000
MBO	Count	29.000	4.000	33.000
	Expected count	30.339	2.661	33.000
University	Count	20.000	3.000	23.000
	Expected count	21.145	1.855	23.000
Total	Count	114.000	10.000	124.000
	Expected count	114.000	10.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	2.857	3	0.414
N	124		

Contingency Tables

What is the highest level of education you have achieved?		Tea		
		Correct	**Incorrect**	**Total**
HBO	Count	31.000	22.000	53.000
	Expected count	34.194	18.806	53.000
High School	Count	10.000	5.000	15.000
	Expected count	9.677	5.323	15.000
MBO	Count	19.000	14.000	33.000
	Expected count	21.290	11.710	33.000
University	Count	20.000	3.000	23.000
	Expected count	14.839	8.161	23.000
Total	Count	80.000	44.000	124.000
	Expected count	80.000	44.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	6.625	3	0.085
N	124		

Contingency Tables

What is the highest level of education you have achieved?		Fruit Juice		
		Correct	Incorrect	Total
HBO	Count	32.000	21.000	53.000
	Expected count	33.339	19.661	53.000
High School	Count	7.000	8.000	15.000
	Expected count	9.435	5.565	15.000
MBO	Count	23.000	10.000	33.000
	Expected count	20.758	12.242	33.000
University	Count	16.000	7.000	23.000
	Expected count	14.468	8.532	23.000
Total	Count	78.000	46.000	124.000
	Expected count	78.000	46.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	2.930	3	0.403
N	124		

Contingency Tables

What is the highest level of education you have achieved?		Soft drinks with added sugar		
		Correct	Incorrect	Total
HBO	Count	51.000	2.000	53.000
	Expected count	52.145	0.855	53.000
High School	Count	15.000	0.000	15.000
	Expected count	14.758	0.242	15.000
MBO	Count	33.000	0.000	33.000
	Expected count	32.468	0.532	33.000
University	Count	23.000	0.000	23.000
	Expected count	22.629	0.371	23.000
Total	Count	122.000	2.000	124.000
	Expected count	122.000	2.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	2.723	3	0.436
N	124		

Contingency Tables

What is the highest level of education you have achieved?		Soft drinks with artificial sweeteners		
		Correct	**Incorrect**	**Total**
HBO	Count	50.000	3.000	53.000
	Expected count	50.863	2.137	53.000
High School	Count	15.000	0.000	15.000
	Expected count	14.395	0.605	15.000
MBO	Count	32.000	1.000	33.000
	Expected count	31.669	1.331	33.000
University	Count	22.000	1.000	23.000
	Expected count	22.073	0.927	23.000
Total	Count	119.000	5.000	124.000
	Expected count	119.000	5.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	1.085	3	0.781
N	124		

Chi-squared tests : Question 8 versus demographical factors

- **Question 8 : Beverages with artificial sweeteners contain fewer calories than beverages with sugar?**
- **Question 3 : Demographical factor Gender**

Contingency Tables

Beverages with artificial sweeteners contain fewer calories than beverages with sugar?		What is your gender?		
		Male	**Female**	**Total**
True	Count	16.000	53.000	69.000
	Expected count	18.363	50.637	69.000
Not true	Count	10.000	20.000	30.000
	Expected count	7.984	22.016	30.000
I don't know	Count	7.000	18.000	25.000
	Expected count	6.653	18.347	25.000
Total	Count	33.000	91.000	124.000
	Expected count	33.000	91.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	1.133	2	0.568
N	124		

- **Question 8 : Beverages with artificial sweeteners contain fewer calories than beverages with sugar?**
- **Question 4 : Demographical factor Age**

Contingency Tables

Beverages with artificial sweeteners contain fewer calories than beverages with sugar?		What is your age?			
		18 - 34 years	35 - 54 years	55+	Total
True	Count	36.000	25.000	8.000	69.000
	Expected count	40.621	18.363	10.016	69.000
Not true	Count	16.000	7.000	7.000	30.000
	Expected count	17.661	7.984	4.355	30.000
I don't know	Count	21.000	1.000	3.000	25.000
	Expected count	14.718	6.653	3.629	25.000
Total	Count	73.000	33.000	18.000	124.000
	Expected count	73.000	33.000	18.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	12.809	4	0.012
N	124		

- ↓ **Question 8 : Beverages with artificial sweeteners contain fewer calories than beverages with sugar?**
- ↓ **Question 5 : Demographical factor Educational level**

Contingency Tables

Beverages with artificial sweeteners contain fewer calories than beverages with sugar?		What is the highest level of education you have achieved?				Total
		University	HBO	MBO	High School	
True	Count	12.000	32.000	18.000	7.000	69.000
	Expected count	12.798	29.492	18.363	8.347	69.000
Not true	Count	7.000	13.000	8.000	2.000	30.000
	Expected count	5.565	12.823	7.984	3.629	30.000
I don't know	Count	4.000	8.000	7.000	6.000	25.000
	Expected count	4.637	10.685	6.653	3.024	25.000
Total	Count	23.000	53.000	33.000	15.000	124.000
	Expected count	23.000	53.000	33.000	15.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	5.300	6	0.506
N	124		

Chi-squared tests : Question 9 versus demographical factors

- **Question 9 : Consuming products sweetened with artificial sweeteners is a good option when you want to lose weight?**
- **Question 3 : Demographical factor Gender**

Contingency Tables

Consuming products sweetened with artificial sweeteners is a good option when you want to lose weight?		What is your gender?		
		Male	**Female**	**Total**
True	Count	9.000	38.000	47.000
	Expected count	12.508	34.492	47.000
Not true	Count	14.000	34.000	48.000
	Expected count	12.774	35.226	48.000
I don't know	Count	10.000	19.000	29.000
	Expected count	7.718	21.282	29.000
Total	Count	33.000	91.000	124.000
	Expected count	33.000	91.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	2.421	2	0.298
N	124		

- **Question 9 : Consuming products sweetened with artificial sweeteners is a good option when you want to lose weight?**
- **Question 4 : Demographical factor Age**

Contingency Tables

Consuming products sweetened with artificial sweeteners is a good option when you want to lose weight?		What is your age?			
		18 - 34 years	35 - 54 years	55+	Total
True	Count	28.000	14.000	5.000	47.000
	Expected count	27.669	12.508	6.823	47.000
Not true	Count	22.000	16.000	10.000	48.000
	Expected count	28.258	12.774	6.968	48.000
I don't know	Count	23.000	3.000	3.000	29.000
	Expected count	17.073	7.718	4.210	29.000
Total	Count	73.000	33.000	18.000	124.000
	Expected count	73.000	33.000	18.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	9.478	4	0.050
N	124		

- ⬦ **Question 9 : Consuming products sweetened with artificial sweeteners is a good option when you want to lose weight?**
- ⬦ **Question 5 : Demographical factor Educational level**

Contingency Tables

Consuming products sweetened with artificial sweeteners is a good option when you want to lose weight?		What is the highest level of education you have achieved?				
		University	HBO	MBO	High School	Total
True	Count	7.000	25.000	11.000	4.000	47.000
	Expected count	8.718	20.089	12.508	5.685	47.000
Not true	Count	10.000	16.000	16.000	6.000	48.000
	Expected count	8.903	20.516	12.774	5.806	48.000
I don't know	Count	6.000	12.000	6.000	5.000	29.000
	Expected count	5.379	12.395	7.718	3.508	29.000
Total	Count	23.000	53.000	33.000	15.000	124.000
	Expected count	23.000	53.000	33.000	15.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	5.272	6	0.509
N	124		

Chi-squared tests : Question 10 versus demographical factors

- **Question 10 : Consuming products sweetened with artificial sweeteners will help me in preventing getting diabetes and cardiovascular diseases?**
- **Question 3 : Demographical factor Gender**

Contingency Tables

Consuming product sweetened with artficial sweeteners will help me in preventing getting diabetes and cardiovascular diseases?		What is your gender?		
		Male	**Female**	**Total**
True	Count	9.000	25.000	34.000
	Expected count	9.048	24.952	34.000
Not true	Count	12.000	34.000	46.000
	Expected count	12.242	33.758	46.000
I don't know	Count	12.000	32.000	44.000
	Expected count	11.710	32.290	44.000
Total	Count	33.000	91.000	124.000
	Expected count	33.000	91.000	124.000

Chi-Squared Tests

	Value	df	p
X²	0.017	2	0.992
N	124		

- **Question 10 : Consuming products sweetened with artificial sweeteners will help me in preventing getting diabetes and cardiovascular diseases?**
- **Question 4 : Demographical factor Age**

Contingency Tables

Consuming product sweetened with artficial sweeteners will help me in preventing getting diabetes and cardiovascular diseases?		What is your age?			
		18 - 34 years	35 - 54 years	55+	Total
True	Count	19.000	11.000	4.000	34.000
	Expected count	20.016	9.048	4.935	34.000
Not true	Count	24.000	12.000	10.000	46.000
	Expected count	27.081	12.242	6.677	46.000
I don't know	Count	30.000	10.000	4.000	44.000
	Expected count	25.903	11.710	6.387	44.000
Total	Count	73.000	33.000	18.000	124.000
	Expected count	73.000	33.000	18.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	4.448	4	0.349
N	124		

Question 10 : Consuming products sweetened with artificial sweeteners will help me in preventing getting diabetes and cardiovascular diseases?

Question 5 : Demographical factor Educational level

Contingency Tables

Consuming product sweetened with artficial sweeteners will help me in preventing getting diabetes and cardiovascular diseases?		What is the highest level of education you have achieved?				
		University	HBO	MBO	High School	Total
True	Count	5.000	15.000	12.000	2.000	34.000
	Expected count	6.306	14.532	9.048	4.113	34.000
Not true	Count	9.000	20.000	11.000	6.000	46.000
	Expected count	8.532	19.661	12.242	5.565	46.000
I don't know	Count	9.000	18.000	10.000	7.000	44.000
	Expected count	8.161	18.806	11.710	5.323	44.000
Total	Count	23.000	53.000	33.000	15.000	124.000
	Expected count	23.000	53.000	33.000	15.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	3.425	6	0.754
N	124		

Chi-squared tests : Question 11 versus demographical factors & Question 7, 8, 9, 10

- ⚜ **Question 11 : Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?**
- ⚜ **Question 3 : Demographical factor Gender**

Contingency Tables

Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?		What is your gender?		
		Male	Female	Total
Yes, I will consume them more	Count	2.000	0.000	2.000
	Expected count	0.532	1.468	2.000
Yes, I will consume them less	Count	17.000	46.000	63.000
	Expected count	16.766	46.234	63.000
No, I will still consume them in the same amounts	Count	14.000	45.000	59.000
	Expected count	15.702	43.298	59.000
Total	Count	33.000	91.000	124.000
	Expected count	33.000	91.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	5.771	2	0.056
N	124		

- **Question 11 : Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?**
- **Question 4 : Demographical factor Age**

Contingency Tables

Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?		What is your age?			
		18 - 34 years	**35 - 54 years**	**55+**	**Total**
Yes, I will consume them more	Count	2.000	0.000	0.000	2.000
	Expected count	1.177	0.532	0.290	2.000
Yes, I will consume them less	Count	31.000	19.000	13.000	63.000
	Expected count	37.089	16.766	9.145	63.000
No, I will still consume them in the same amounts	Count	40.000	14.000	5.000	59.000
	Expected count	34.734	15.702	8.565	59.000
Total	Count	73.000	33.000	18.000	124.000
	Expected count	73.000	33.000	18.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	6.786	4	0.148
N	124		

- **Question 11 : Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?**
- **Question 5 : Demographical factor Educational level**

Contingency Tables

Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?		What is the highest level of education you have achieved?				
		University	HBO	MBO	High School	Total
Yes, I will consume them more	Count	0.000	1.000	1.000	0.000	2.000
	Expected count	0.371	0.855	0.532	0.242	2.000
Yes, I will consume them less	Count	12.000	27.000	17.000	7.000	63.000
	Expected count	11.685	26.927	16.766	7.621	63.000
No, I will still consume them in the same amounts	Count	11.000	25.000	15.000	8.000	59.000
	Expected count	10.944	25.218	15.702	7.137	59.000
Total	Count	23.000	53.000	33.000	15.000	124.000
	Expected count	23.000	53.000	33.000	15.000	124.000

Chi-Squared Tests

	Value	df	p
X²	1.249	6	0.974
N	124		

- ♦ **Question 11 : Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?**
- ♦ **Question 7 : Indicate all products which are part of the "schijf van vijf"?**

Contingency Tables

Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?	Water		
	Correct	Incorrect	Total
Yes, I will consume them more	2	0	2
Yes, I will consume them less	57	6	63
No, I will still consume them in the same amounts	55	4	59
Total	114	10	124

Chi-Squared Tests

	Value	df	p
X²	0.488	2	0.784
N	124		

Contingency Tables

Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?	Tea		
	Correct	Incorrect	Total
Yes, I will consume them more	0	2	2
Yes, I will consume them less	43	20	63
No, I will still consume them in the same amounts	37	22	59
Total	80	44	124

Chi-Squared Tests

	Value	df	p
X²	4.105	2	0.128
N	124		

Contingency Tables

Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?	Fruit Juice		
	Correct	Incorrect	Total
Yes, I will consume them more	0	2	2
Yes, I will consume them less	40	23	63
No, I will still consume them in the same amounts	38	21	59
Total	78	46	124

Chi-Squared Tests

	Value	df	p
X²	3.458	2	0.177
N	124		

Contingency Tables

Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?	Soft drinks with added sugar		
	Correct	Incorrect	Total
Yes, I will consume them more	2	0	2
Yes, I will consume them less	62	1	63
No, I will still consume them in the same amounts	58	1	59
Total	122	2	124

Chi-Squared Tests

	Value	df	p
X²	0.036	2	0.982
N	124		

Contingency Tables

Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?	Soft drinks with artificial sweeteners		
	Correct	Incorrect	Total
Yes, I will consume them more	1	1	2
Yes, I will consume them less	61	2	63
No, I will still consume them in the same amounts	57	2	59
Total	119	5	124

Chi-Squared Tests

	Value	df	p
X²	11.104	2	0.004
N	124		

- **Question 11 : Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?**
- **Question 8 : Beverages with artificial sweeteners contain fewer calories than beverages with sugar?**

Contingency Tables

Would you change your consumption pattern of products containing artificial sweeteners after being informed about the potential health effects?		Beverages with artificial sweeteners contain fewer calories than beverages with sugar?			
		True	**Not true**	**I don't know**	**Total**
Yes, I will consume them more	Count	2.000	0.000	0.000	2.000
	Expected count	1.113	0.484	0.403	2.000
Yes, I will consume them less	Count	37.000	15.000	11.000	63.000
	Expected count	35.056	15.242	12.702	63.000
No, I will still consume them in the same amounts	Count	30.000	15.000	14.000	59.000
	Expected count	32.831	14.274	11.895	59.000
Total	Count	69.000	30.000	25.000	124.000
	Expected count	69.000	30.000	25.000	124.000

Chi-Squared Tests

	Value	df	p
X^2	2.587	4	0.629
N	124		